AERONAUTICS
Vol. XLIX

MARCH 28th, 1946

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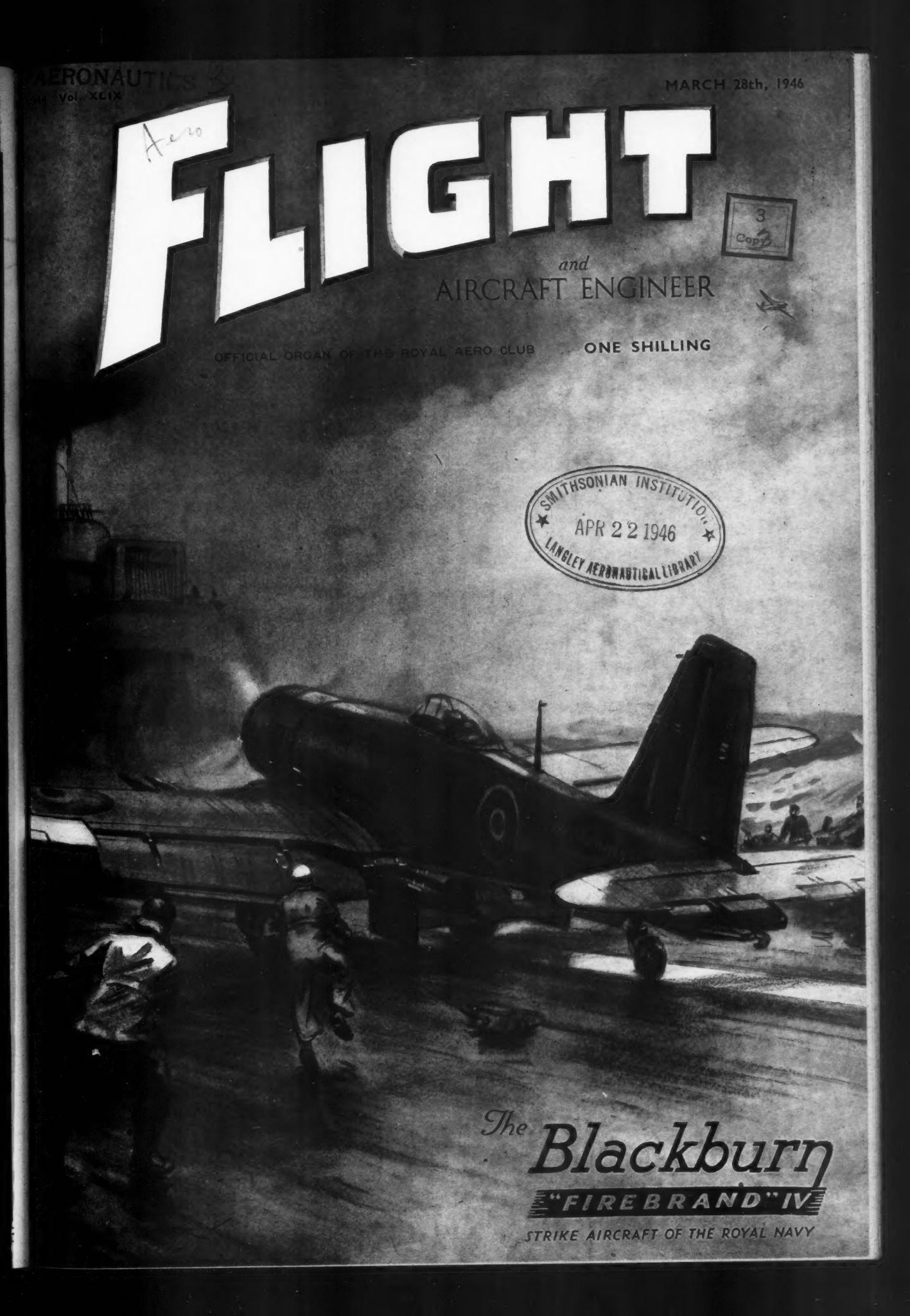

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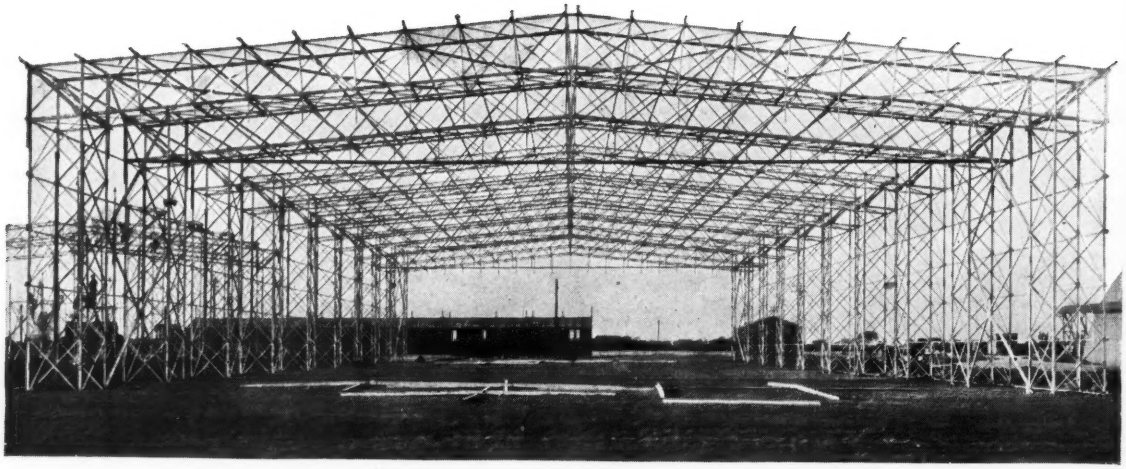

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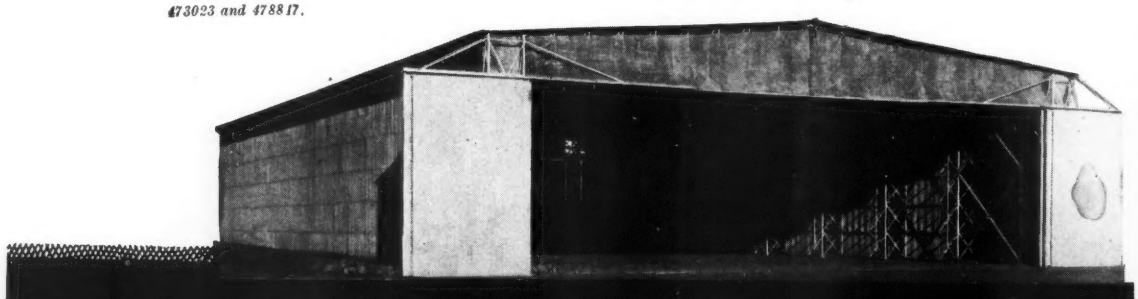

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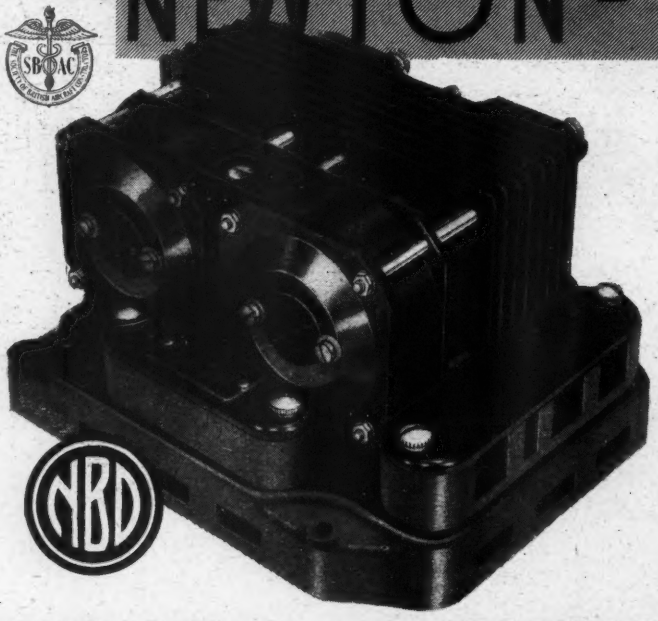

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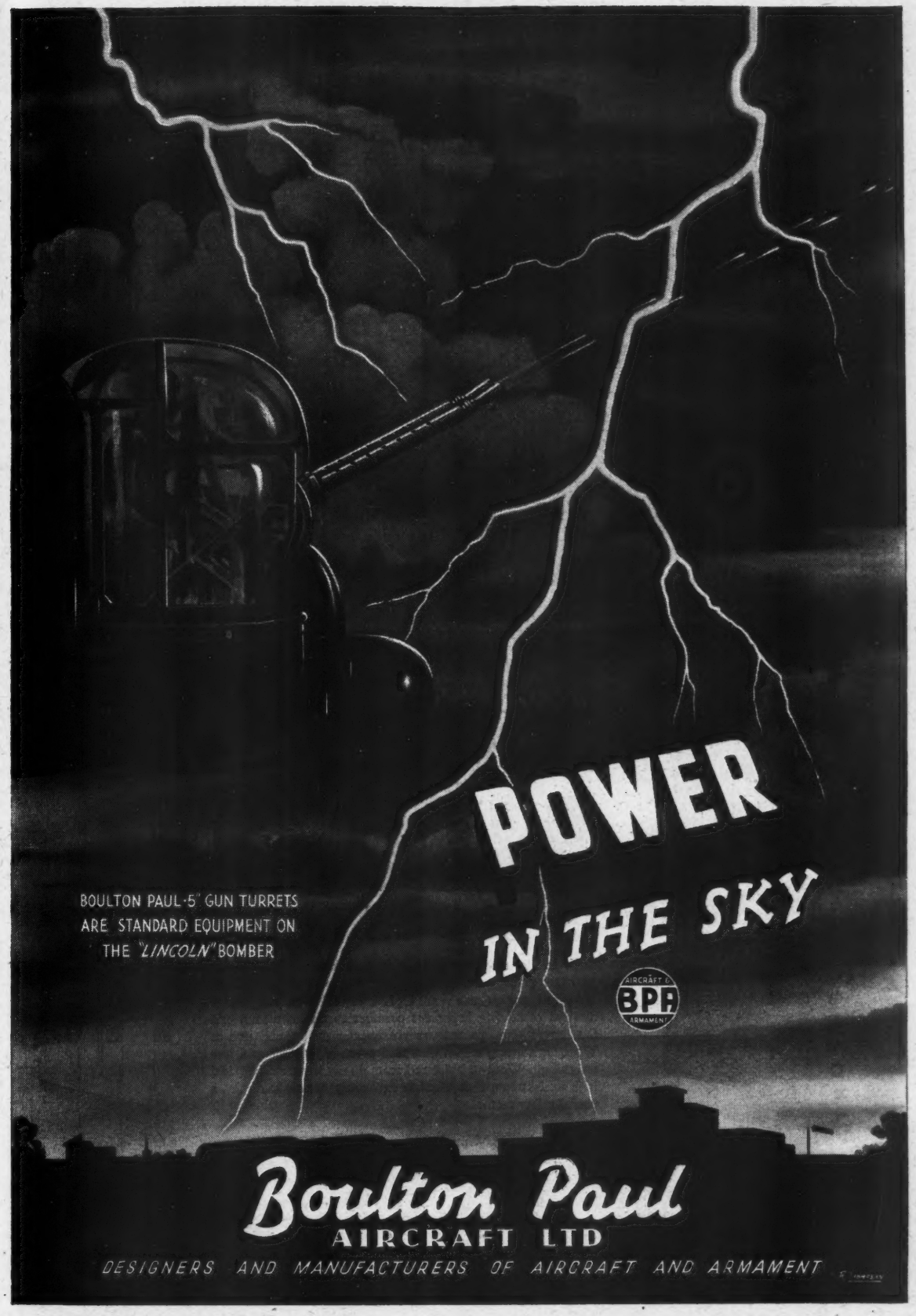
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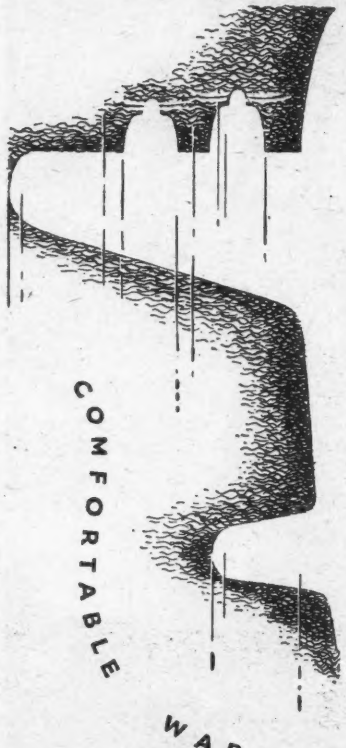

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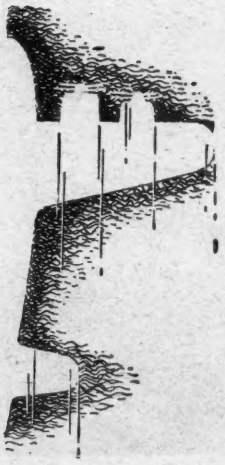

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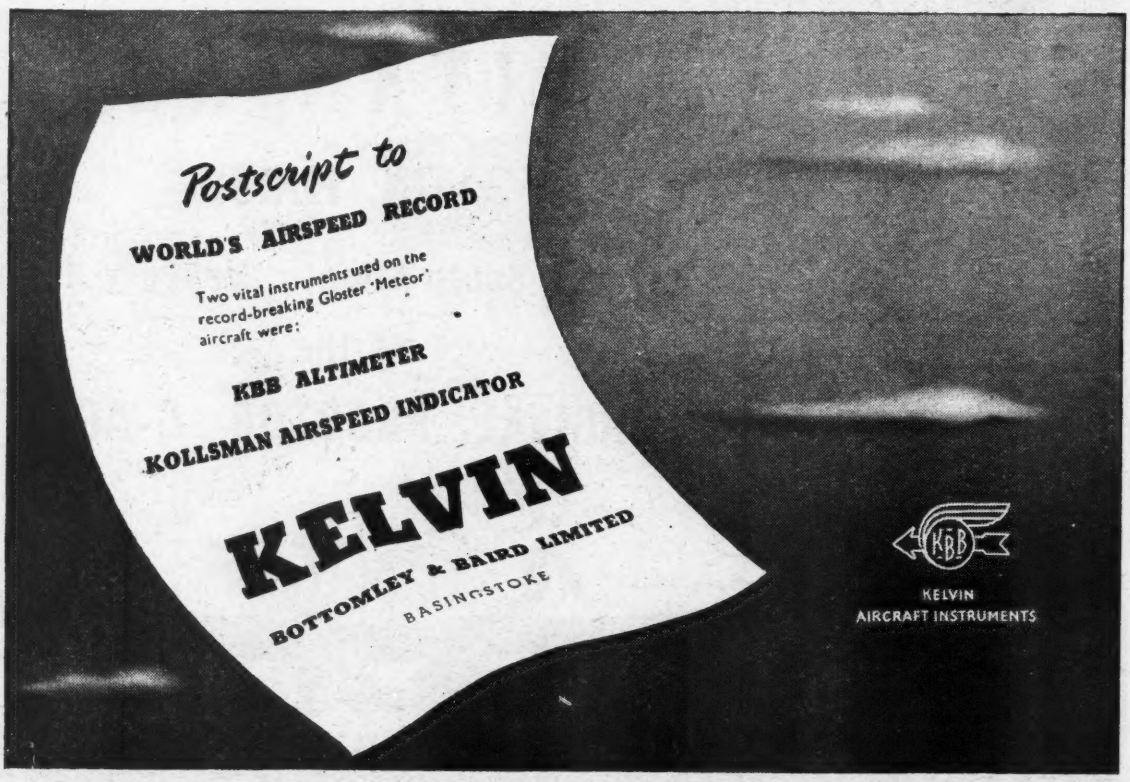

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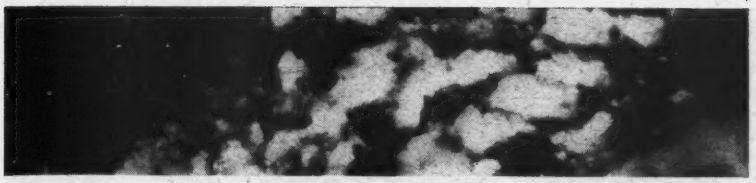

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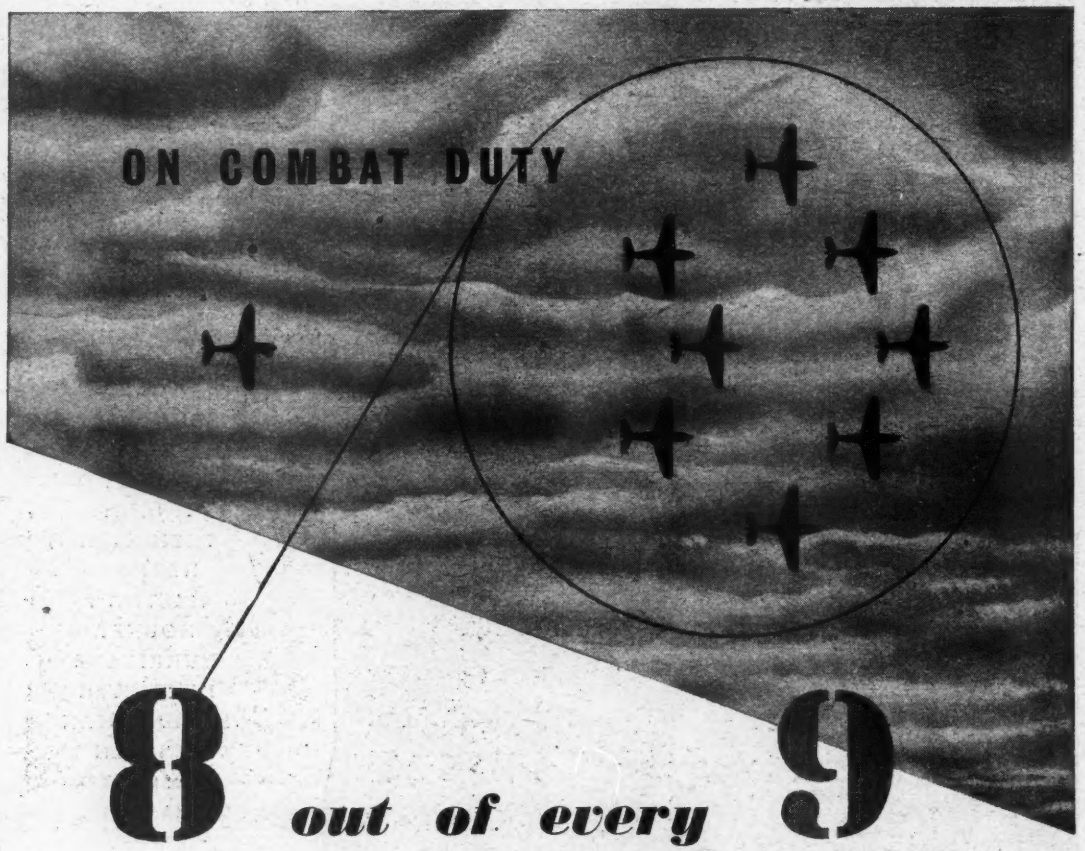

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The Outlook

Turbine Maintenance

DURING the all-day debate on the application of gas turbines to aircraft propulsion at the Royal Aeronautical Society recently, Air Commodore Worstall referred to the reduction by 50 per cent in the number of engine fitters needed at his fighter station since the squadrons were equipped with jet-propelled aircraft. That there is still room for improvement goes without saying, and the Air Commodore mentioned several respects in which jet-propelled aircraft are at a disadvantage. Electric starters was one He quoted 700 amps as the consumption of the Derwent, and 1,000 amps for the later Goblins, suggesting that a two-stroke petrol engine starter would be a welcome alternative. In point of fact, we believe this change is being made.

More rapid refuelling was another improvement demanded for, as the Air Commodore put it, in spite of what Dr. Hooker had said, the jet engines need a lot of fuel. Greater accessibility to the jet units in the aircraft would be welcomed, but as Mr. Carter retorted, if all these things were attended to, there would be no need for engine fitters in the R.A.F.!

All jesting apart, however, there appears to be no doubt that turbine engines do require very little attention during their, at present, somewhat short period of installed life. An article in this issue, by an expert on maintenance and servicing, makes it clear just how few man-hours are needed to keep jet units in running order. The period between overhauls is short at the moment, but as our contributor points out, that is mainly a precautionary measure, and there is every reason to believe that this period will gradually be extended until it equals or surpasses that of piston engines. After all, the gas turbine is very young, and the remarkable thing is that already it has accomplished so much with so little trouble.

In civil aviation, where it has not yet been tried, the gas turbine should effect an even more welcome saving in man-hours than in service aircraft. There is usually no great scarcity of man-power in the R.A.F., but in the commercial world the simplicity of the gas turbine, and the relatively short time needed for inspection and adjustments can make a very appreciable difference to the balance sheet of an airline by making possible a quicker turn-round, thus enabling an aircraft to put in more working hours in a year. That would help to pay for the greater fuel consumption with which most people think we shall have to put up in spite of any disclaimers to the contrary.

Powerless Helicopter Landings

MAIN advantages claimed for the helicopter type of aircraft are that it can take-off and land vertically, using a very confined space as its "airfield." The former is true, the latter only with qualifications. And even in vertical ascent the power required is a good deal greater than if a climb is made with some forward speed.

In this issue we publish an article, by an officer who has made a number of dead-engine landings with helicopters, in which he outlines various techniques. The vertical descent followed by a touch-down without forward speed is much too risky, owing to the very high sinking speed.

The two alternative methods recommended are a glide approach followed by a touch-down at forward speed, and a glide approach terminating in a vertical touch-down. The former of these is very similar to landing an Autogiro. In the latter the pilot uses finer rotor-blade pitch for the glide approach, increasing the pitch to slow-down the rate of descent just before touching down. This method may, perhaps, be said to require a degree of piloting skill comparable with that needed in the old days to make a so-called "Gosport landing," viz., a sideslip to within a few feet of the ground, followed by a last-minute straightening-up and heading

into wind. It shortened the landing run. Perhaps the author of the article does not stress sufficiently the really critical aspect of landing a helicopter with a "dead" engine. This is the very short period, a matter of a second or two, which is the greatest time lag that can be tolerated before the blades are changed into fine pitch for autorotation when the engine stops. In the latest types of helicopter this pitch change is effected automatically.

Ethics or Logic?

MANY years ago, Fritz Koolhoven designed a B.A.T. commercial aircraft in which the pilot was seated very far back in the fuselage. Asked why he had placed the pilot in this position, Koolhoven replied that this part of the machine was usually undamaged in a crash, and so there was a good chance of the pilot living to explain what went wrong.

About the same time or a little later, "George" Bulman was asked by our photographer, who did not wear a parachute while Bulman did, what he would do if the machine got into any difficulty from which the pilot could obviously not save it. His reply was that he would bale out, since he could do nothing anyway to help his passenger by staying with the machine.

We are reminded of these two views by the correspondence which has been appearing in our columns lately, in which one suggestion is that members of a civil aircraft crew should be provided with a parachute and dinghy in order that they might be picked up later and be able to give an account of what happened.

In this issue a correspondent asks what would be the effect on the passengers? He comes to the conclusion that they, too, would ask for means of escape, and he makes the suggestion that fewer passengers should be carried and the rest be supplied with parachute-dinghies. The operator is not likely to view with favour the double penalty of losing valuable revenue and at the same time incurring extra weight in the shape of parachute-dinghies for his reduced number of passengers.

The suggestion that one or more members of the crew should be provided with means for escape, to the benefit of future safety, is logical if it is quite impossible to make such means available to all on board. Mr. Bulman was logical in his argument, but the ethics of the decision might be challenged by some. It might be remembered, however, that many passengers would flatly refuse to bale out unless the action was carried out for them.

CONTENTS

The Outlook	305
Helicopter Landing Technique	307
Here and There	309
Eternal Triangle	311
Night by Day	312
Britain's Test Pilots	314
Tyres for To-morrow	316
Design for Comfort	a
Keeping Them Running	319
Civil Aviation	323
Correspondence	325
Service Aviation	327

MORE BRITISH EXPORTS? Last week the Emir Abdullah of Transjordan visited the de Havilland works at Hatfield, where he saw the Hornet and Vampire demonstrated. The Emir is seen here being shown a scale model of the Goblin jet engine by Major Frank B. Halford.

Helicopter Landing Technique

A "Dead" Engine Does Not Mean a Crash : Using the Kinetic Energy in the Rotor Blades

By Lt. (A) C. T. D. HOSEGOOD, R.N.V.R.

FROM articles and descriptions which have appeared in this journal during the last few years, readers of *Flight* will certainly be familiar with the basic difference between an Autogiro and a helicopter. They will not need to be reminded that in the former the rotor is kept rotating by the air forces acting upon it under the forward speed imparted to the machine by the thrust of its engine-driven airscrew, whereas in the helicopter the rotor is driven direct by the engine and, by the forward tilt of the whole aircraft, gives propulsion as well as lift.

They will also be aware that lift is varied, in conjunction with engine power, by changing the pitch of all the rotor blades, and that the functions corresponding to elevator and aileron controls in fixed-wing aircraft are performed by a cyclic pitch change of the blades on their circular path. They may, however, be in some little doubt about what the pilot has to do in case of engine stoppage. Most of them will be aware that a freewheel arrangement is incorporated so that when the engine stops, the rotor continues to rotate (autorotation, it is called) just as does the rotor of an Autogiro.

Landing a helicopter with the engine stopped is, however, not quite such a simple matter as in an Autogiro, mainly because the rotor is more heavily loaded, so that the sinking rate is much higher, well over 1,000 ft/min in fact. Does this mean, then, that with a "dead" engine a crash is inevitable? By no means. Many such landings have been made without damage to the aircraft. There are several ways in which a landing may be made safely, but in the main they may be divided into three groups the techniques of which will now be explained.

In normal powered flight the pitch setting on the main blades is too great to allow autorotation, and if this pitch is not altered, the rotor will slow down and, owing to loss of centrifugal force, will then "cone up." This "coning" is dangerous, but cannot occur unless the rotor revolutions are allowed to fall below the minimum number permissible. In autorotation the revs are governed by the pitch setting, the higher the pitch the lower the revs and vice versa. The rate of descent is also connected with the amount of pitch applied. However, with the most favourable pitch setting, the rate of descent in present helicopters is well above 1,000 ft per min and it is, therefore, thought advisable to accept a slightly greater rate of descent in exchange for high rotor revs and the consequent high degree of kinetic energy built-up in the blades.

Instant Action Essential

The period between engine failure and the "slowing down" of the rotor blades to the minimum permissible number is, in present machines, small and no time should be lost before a reduction in pitch is made. This period depends directly on the pitch setting and the number of rotor revs at the time of engine failure. It would, therefore, seem wise to maintain high engine revs and use fine pitch in normal powered flight, but this at the moment is not practical and would amount to flying a fixed-wing aircraft in "fine pitch" the whole time — with much the same results. With the helicopter rotor in autorotation, the rate of descent must in some way be reduced before an actual landing can be made. The "touch-down" speed of a helicopter, even in autorotation, *can* be achieved at zero air speed, but this is not always necessary and if the selected landing ground has a good surface it may well be advantageous to touch down with some forward motion.

With engine stopped and the blades in autorotation, a helicopter can be landed in gliding approach and at forward speed; with gliding approach followed by vertical touch-down; or in vertical approach. The last-named is dangerous owing to the high sinking speed.

Let us now examine three different methods of landing a helicopter in autorotation.

1. *With Vertical Approach.* In "no-wind" conditions a vertical descent in present helicopters is not very satisfactory. It results in an uncomfortably high rate of descent (ap-

HELICOPTER LANDING TECHNIQUE

proximately 2,000 ft per min) which can only be reduced by means of an increase in pitch of the main rotor and the use of the kinetic energy in the blades. In this type of approach, the control column is of no assistance in the actual landing. It would appear that in present helicopters the initial increase in pitch may be made when the aircraft is one hundred feet above the ground, or left as late as ten feet up. These would be the two extreme cases. In the first example, the application of pitch would have to be made gently, and the main danger would be that all the kinetic energy would be lost from the blades before the touch-down was effected. In the latter case, a rapid application of pitch would be necessary, and a possibility of stalling the blades would be present. To my knowledge, no landings of this type have yet been made, and this method applies more to helicopters of the future than to those of the present.

2. *Glide approach and landing with forward speed.* With an air speed of 50 m.p.h. it is quite possible to make a conventional landing with the use of the control column alone. In this type of landing, the pitch lever can be set at the optimum setting and then ignored. The rate of descent will not be as high as in the vertical approach and can be reduced by the control column as in an ordinary aircraft. In fact, in all three stages of "check," "float" and "touch-down," this type of helicopter landing resembles that of a fixed-wing aircraft

With a "touch-down" speed of approximately 25 m.p.h., the helicopter will not run far, as at low speeds the rotor acts as a brake and will quickly bring the machine to a standstill. This is not a difficult way of landing without power, and if the ground surface is good and free of obstructions, there can be no objections. Many landings of this type have already been made in existing helicopters.

3. *Glide approach and landing with zero air speed.* As is so often the case, the most satisfactory type of forced landing lies somewhere between the two extremes. In this type the initial approach is made with an air speed of approximately 50 m.p.h., as in the landing with forward speed just described. There is, however, one difference. This concerns the pitch setting, which should be set at minimum instead of optimum incidence. The initial check with the control column should now be made a little higher, and as the effectiveness of the control column decreases (as it will with the reduction of the air speed) an increase of pitch can be applied. The increase of pitch will increase the already rapid deceleration of the aircraft, and it is quite possible to lower it on to the ground without any forward movement whatsoever.

Numerous power-off landings have already been made without incident in this manner.

While there can be no fixed method of landing in autorotation, there are a number of ways which, depending upon circumstances, may all be equally safe, and owing to the fact that low, and even zero, air speeds may be used, they should prove safer than the high speeds necessary in fixed-wing aircraft. Even in the case of light aircraft, where landings at abnormally low speeds are possible, pilots experienced on both types to whom I have spoken all agree that if they must make a forced landing they hope it will be in a helicopter.

POWER FOR THE TUDOR II.

IN this issue we publish an article on the Avro Tudor II, which is powered with four Rolls-Royce Merlin 102 engines. This particular series of Merlin is the first and only engine in the world yet to have successfully completed the new type-test requirements for civil aircraft engines recently formulated by the Air Registration Board.

With a background of over 150,000 Merlin engines produced in this country and America before the end of the war in Europe, the new type can be said to start its career with a wealth of experience, under all sorts of operating conditions, which has certainly never been equalled, and probably never will be equalled by any other engine.

On many of the projected civil routes—and in particular the North Atlantic route—the normal cruising altitude has been nominally fixed at between 20,000 and 25,000ft and, as a consequence, it is essential that the power units should have an appropriate high-altitude performance. Rolls-Royce, it will be remembered, pioneered the development of the mechanically driven two-stage supercharger with after-cooler for military purposes, and the blower incorporated in the Merlin 102 is of an improved type with an overhung first-stage impeller designed to give the least possible restriction of charge-flow into the eye of the first stage.

PRINCESS ELIZABETH LAUNCHES H.M.S. "EAGLE"

H.M.S. EAGLE, first of the new 40,000-ton Ark Royal class of aircraft carriers, was launched by Princess Elizabeth at Harland and Wolff's yard at Belfast on March 19th. The Princess was accompanied by the Governor of Northern Ireland, Earl Granville; the Countess of Granville, her aunt; the Prime Minister, Sir Basil Brooke; the First Sea Lord, Admiral of the Fleet Viscount Cunningham of Hyndhope; and the chairman and managing director of Harland and Wolff, Sir Frederick Rebbeck.

At the luncheon which followed the launching ceremony, the Princess referred to the old H.M.S. *Eagle*. "In August, 1942," she said, "a great and gallant ship sank in the Mediterranean. To-day, in March, 1946, her spirit has risen again in the new *Eagle* whom we have just seen launched."

The old *Eagle* (22,600 tons) was originally laid down as a battleship for the Chilian Navy, but when war broke out in 1914 was taken over by the British Admiralty. She was not finished in time to take part in the fighting, however, and was converted into an aircraft carrier in 1924.

Between the wars she spent a good deal of her time on the China station, and during the first half of World War II gave useful service in the Mediterranean before an enemy U-boat sent her to the bottom. Her Swordfish took part in the famous raid on Taranto Harbour.

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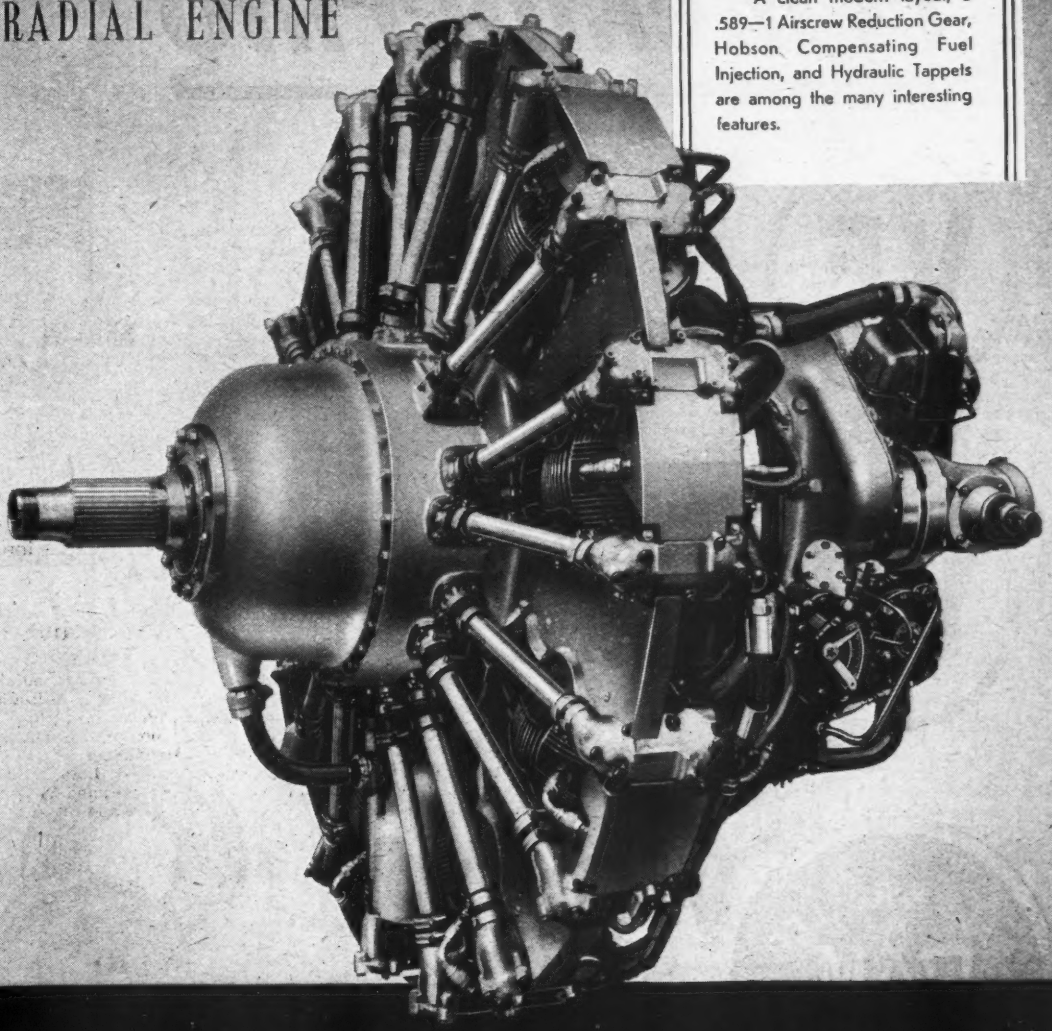

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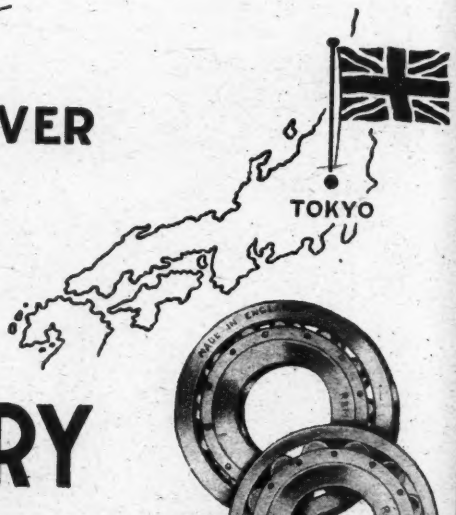

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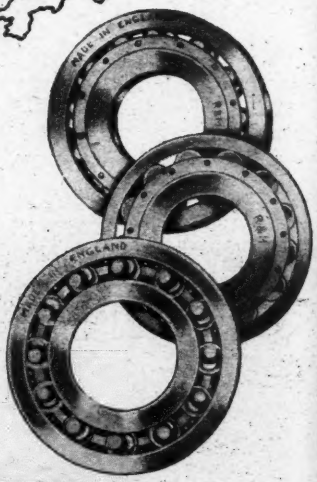
VICTORY OVER FRICTION



RANSOME & MARLES BEARING CO. LTD. NEWARK ON TRENT ENGLAND

HERE AND THERE

OFF DUTY : Skis are among the many amenities provided for airmen and "Waafs" at Gatow Airport, Berlin. With winter sports laid on, Service life in Germany has its compensations.

Disbanded

THE Air Ministry announced last week that British Air Command, which has been implementing R.A.F. policy in Berlin since last April, has now been disbanded.

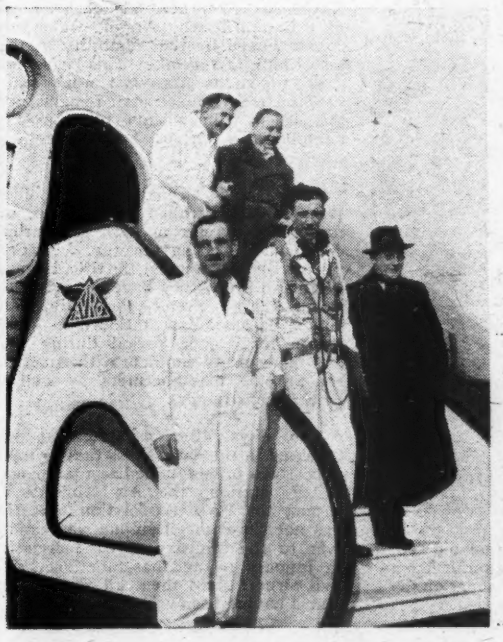
Most of the local administration formerly dealt with by British Air Command is being taken over by the R.A.F. Station at Gatow, commanded by Group Capt. D. M. Somerville.

Australian Avros

THE first Lincoln bomber to be built in Australia flew over Melbourne last week in an aerial display which formed part of a security loan campaign.

The aircraft is the first of 61 of this type authorized by the Department of Aircraft Production for the R.A.A.F.

A Melbourne message states (somewhat vaguely, since no mark number is given) that the Department has also authorized the construction of 12 Tudors in Australian factories.



FIRST FLIGHT : Avro personalities descend from the Tudor II after its successful maiden flight recently. In front is chief test pilot, S. A. Thorn, and on the steps (left to right) are Capt. J. Orrell, 2nd pilot, Mr. Roy Chadwick, chief designer, Mr. Bowers, flight engineer, and Mr. C. E. Fielding, director of production.

THOR Flies South

THE Lancaster, *Thor*, of the Empire Air Armament School, Manby, has now gone on an extensive tour of Australia and New Zealand, carrying a mission of specialists in bombing and gunnery drawn from the R.A.F. and Dominion Air Forces. The mission will discuss problems connected with air armament and will exchange views on aircrew training with Dominion representatives.

Thor, it will be remembered, carried out a similar mission to the Middle East, Southern Rhodesia, and South Africa last autumn. It is fitted with all the latest armament and radar equipment used by the R.A.F.

New Atom Chief

LORD PORTAL of Hungerford has been appointed Controller of Production of Atomic Energy.

Following his resignation as Chief of Air Staff, it was announced in February that he was appointed head of an organization within the Ministry of Supply for the production of material for the Atomic Research and Experimental Establishment at Didcot under the directorship of Professor J. B. Cockroft.

Now Lord Portal will plan all development for industrial and military purposes.

Incidentally it was announced in the Commons last week by Mr. Arthur Henderson, Under-Secretary for India, that the Government would control the disposal of the atomic metal, thorium, found in Travancore, India.

Another Award for Whittle

THE Institution of Mechanical Engineers last week awarded the £1,200 "James Clayton" prize for 1945 to Air Comdre. Frank Whittle, who was also received into honorary membership of the Institution.

The prize, which is for the greatest contribution during the year to modern engineering science, was presented at the annual meeting by the Institution's retiring president, Professor Andrew Robertson, who said that Whittle's gas turbine "may well rank in importance with Parson's steam turbine."

Busier Than Ever

"AT no time in our history have we had so large a volume of prototype and development work." said Mr. A. W. Martyn, chairman of Dowty Equipment, Ltd., when addressing the annual general meeting of the company at Cheltenham recently.

"We are working concurrently," he added, "on such designs as the Bristol Brabazon, Bristol Wayfarer, Avro Tudor, Airspeed Ambassador, and numerous other civil and military types."

Mr. Martyn also mentioned that the firm was about to enter into new markets with products not hithero made in this country for which they believed there would be a wide demand.

FORTHCOMING EVENTS

April 2nd.—R.Ae.S. Bristol Branch: "Research in Aeronautics," by Sir Ben Lockspeiser (Filton House).

April 4th.—Metropolitan Region luncheon meeting, Institute of Motor Industry (London). Lecture by Air Comdre. F. Whittle.

April 6th.—R.A.S. Reading and Dist. Branch. Visit to R.A.E., Farnborough.

Really Co-operative

IT is a well recognized fact that the success of any A.T.C. squadron depends to a considerable extent upon what sort of co-operation it gets from the R.A.F. station to which it is affiliated; it is also well known that such co-operation is apt to vary from place to place.

No. 1,017 (Malvern) Squadron, A.T.C. is among the fortunate units, as was am-

HERE AND THERE

ply demonstrated when they decided to stage a local exhibition of flying equipment and asked Defford R.A.F. Station, to which they are affiliated, if it would lend a hand.

The result was the loan of much interesting equipment to supplement their own, plus the laying on of an impressive aerial pyrotechnic display by one of the station's Lancasters on the night of the opening day. Moreover, the local radar research and experimental station put up some searchlights, and R/T conversations between the Lancaster and the exhibition were relayed over loud speakers for the benefit of visitors.

News in Brief

GROUP CAPT. STEWART O. TUDOR, D.F.C., has gone to India as "trade ambassador" for the S.B.A.C. His office will be in New Delhi.

* * *

Mr. John Strachey, Under-Secretary for Air, has said in a written reply that 24,000 R.A.F. men are still missing or presumed killed in Europe. They were doing their very best to find out what had happened to every man missing from air operations.

* * *

The number of gliders available for instruction at the 90 gliding schools of the A.T.C. is to be increased in order to step up the training of cadets. Additionally, it is expected that a week-end school for gliding instructors in the Corps will be opened at Detling, near Maidstone.

* * *

Commissioned as a squadron officer in the W.A.A.F., the Rev. Elsie Chamberlain became the first woman chaplain in the British Services last week. She will perform the normal duties of a R.A.F. chaplain, but her work will be mainly among W.A.A F. personnel.

* * *

The British Cabinet Mission to India, consisting of Mr. A. V. Alexander, First Lord of the Admiralty, Lord Pethick-Lawrence, Secretary for India, and Sir Stafford Cripps, President of the Board of Trade, flew to India last week. Sir Lawrence Mason, a civil servant in India for 33 years, travelled as Mr. Alexander's personal adviser.

* * *

When Marshal of the R.A.F. Lord Tedder called together his Commanders-in-Chief from all R.A.F. home and overseas commands for a conference at the Air Ministry, it was the first time he had done so since he became Chief of Air Staff on January 1st last. Further conferences are to be held at regular intervals to review progress in the reorganization of the R.A.F.

* * *

No. 5022 Squadron, the first field squadron of the R.A.F.'s airfield construction service, which crossed to the Continent soon after D-Day to prepare landing strips for the Second Tactical Air Force, is now being disbanded. The wartime strength of the squadron was about 500 men.

* * *

After training some 60,000 men—and not a few women, too—in parachute jumping, No. 1 Parachute Training School, R.A.F., has just moved from Ringway, near Manchester, to Upper Hayford, near Oxford. The process of moving began last week and was due to be completed to-day.

* * *

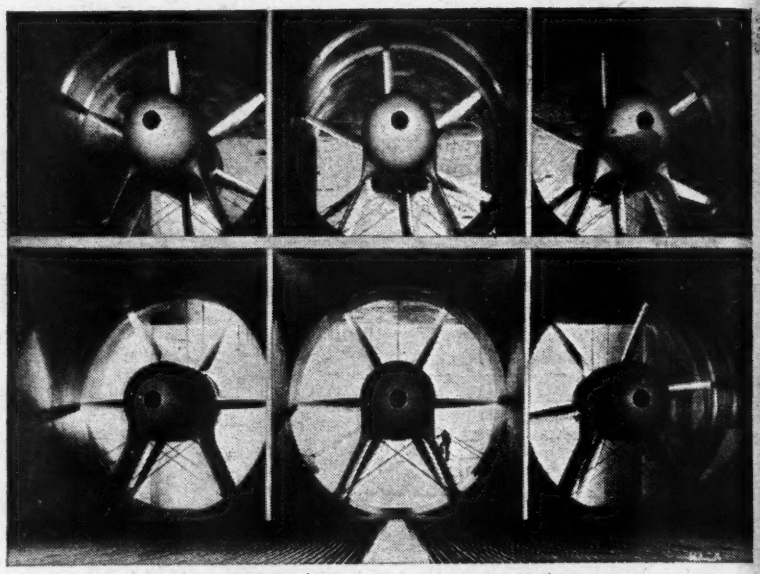
Another Service establishment to disappear from its wartime location is the Naval Air Arm base at Machrihanish, near Campbeltown, Argyll, which was commissioned by the Admiralty in 1941 as H.M.S. *Landrail*. This base was closed down as from last week but a skeleton maintenance staff remains, and the airfield will continue to be used as Campbeltown Airport by Scottish Airways.

* * *

Major Dundas Heenan and Mr. C. J. F. Winn will be recalled by many of our readers in connection with gas turbine development during the war. As Consulting Engineers under the title, Heenan, Winn and Steel, they have opened offices at 29, Clarges Street, Piccadilly, W.1. Major Heenan was stationed in Washington for a long period during 1944 and made many contacts with American gas turbine manufacturers as well as British constructors.

* * *

Two days after a statement had appeared in the daily Press that Lympne airport was to be retained as a permanent R.A.F. station, the Air Ministry informed the Press Association that this was not the case. Lympne was handed over to the Ministry of Civil Aviation on January 1st and has functioned as a civil airport since then, all R.A.F. personnel having been withdrawn.



THE ROARING FORTIES: This battery of six, six-bladed airscrews, each 40ft. in diameter and driven by 1,000 h.p. engines mounted in "blimp" housings, provide the synthetic gale in this wind tunnel at the Ames Aeronautical Laboratory, Moffat Field, U.S.A.

A FAMILY AFFAIR: Mr. and Mrs. T. W. Shipside and their 17-year-old son, Kenneth, are probably the first English family to own and use a light aircraft like a "family car." Here they are seen getting their Auster out of its hangar on the little private airfield adjacent to their home near Nottingham.

Nearing the speed limit
for airscrew propulsion

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ENGINES

THE TUDOR SPIRIT LIVES AGAIN...

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Eternal Triangle

London Airport, Prestwick and the Ministry of Civil Aviation

By "COMMENTATOR"

WE live in an extremely critical world nowadays. This would, undoubtedly, be a good thing were it not for the fact that nearly all the criticism which is levelled to-day is adverse, and it is seldom, apparently, that even the most knowledgeable people have any really helpful criticism to offer. Particularly is this true in the case of anything appertaining to civil aviation.

What is the reason for this attitude? Why is it that so many people delight in placing the grimmest interpretation on every official utterance or decision, usually without any real knowledge of the underlying reasons?

The fact is, of course, that almost everyone nowadays is hopelessly impatient—no doubt as a natural corollary of the change-over from war to peace. Thousands of men and women who have been accustomed to action suddenly find that the rapid tempo of war has given place to the slow and seemingly irksome tempo of peace. In wartime decisions had to be made on the spur of the moment if the country was to be saved from major disaster; now, important and far-reaching decisions are generally made only after considerable research, and this process brings unfamiliar delays—especially so when consideration has to be given to the current difficulties of organising labour, material and finance. Therefore, before one hastens to say that this or that Government decision is useless and will result in the eternal damnation of civil aviation in this country, perhaps one should remember the unpleasant fact that all natural reaction to-day is apparently towards uncharitableness, and adjust one's views accordingly. Also, that constant adverse criticism of British policy by its own people does not enhance our prestige abroad.

A typical example is the case of Heathrow. Everyone now realises that Heathrow was an airfield which, rightly or wrongly, was built out of the R.A.F. Vote with an eye to the future of civil aviation. It is, therefore, not altogether surprising that, as originally planned, Heathrow followed the well-known triangulated R.A.F. airfield form. This form may not be the best for civil purposes, but, if we are charitable, we see that the triangle was planned on such a vast scale that it allowed each of the three initial runways to be duplicated, or even triplicated, and, additionally, it gave plenty of scope for yet a fourth series of runways from north to south.

Those Terminal Buildings

Further, if one examines the layout of the airfield carefully, it also becomes clear that the permanent terminal buildings were to be built outside the main perimeter of the airfield—*not* alongside the Bath Road, but on some other obvious vacant space, such as that in the south-east corner of the airfield. No one planning an airfield of this nature would be likely to put temporary terminal facilities on the site which was required for the permanent buildings. Then, again, a control tower intended to be other than temporary is not likely to be built facing south, so that the controllers have to stare into the sun all day.

What is happening, then, about the final plans for Heathrow? It is reasonable to suppose that the Ministry of Civil Aviation does not want to commit itself publicly until at least a substantial part of the future plans for the airfield are cut and dried, but it is already well known that there is a proposal to take over a large area of land to the north of the Bath Road and to extend the airfield in this direction. At this point, the sensation-mongers produce arguments about scores of houses which have to be pulled down, and hundreds of people who are to be rendered homeless. Maybe a few houses will have to come down, but surely no one seriously imagines that anything worse is likely to happen.

Again, whether the ultimate airfield design will be tangential or otherwise, at the moment no one knows officially. One thing is certain, however—that the works planners at the Ministry of Civil Aviation know a good deal more about airfield layout than do many of the critics whose only knowledge of the subject is in some cases based on the bitter discussions in which they have indulged whilst propping up the odd bar here and there. Let us also acknowledge that the Works Department of the Ministry of Civil Aviation has a nucleus of former members of the Air Ministry Directorate-General of Works which has carried out, on the whole, an extraordinarily good job of work throughout the war, although faced with an incredible number of difficulties. We all know the popular views about "Works and Bricks" held by certain R.A.F. officers and others, but the fact is that such critics are frequently ill-informed. The Department held no executive authority, and, in those instances where seemingly it had boobed badly, it was often only carrying into effect someone else's brilliantly misconceived scheme.

The Claims of Prestwick

Arising out of this Heathrow controversy there is also the question of Prestwick. A letter is printed in our correspondence columns this week from an irate reader who advances the claims of Prestwick over Heathrow. We all know the claims of Prestwick and agree that, on the score of weather, they are justified, but why compare the two airfields? One is in England and the other in Scotland, and, with the best will in the world, the connection between an airfield for Scotland and one for London is hard to see.

Prestwick, rightly, has its claim to become an international airport for Scotland, and this has already been agreed by the Ministry of Civil Aviation. Further, everyone is told that Prestwick is the answer to the pilot's prayer so far as a fair-weather end to an Atlantic air crossing is concerned. It should be realized, however, that this good weather still does not solve the problem of trans-Atlantic passengers who do not want to go to Prestwick, but want to land near London. Prestwick, therefore, is not the answer to poor visibility at Heathrow.

The other claims for Prestwick and Scotland are that it should be run entirely by Scotland for Scotland, and moreover, that the Scots should have the right to make their own international air agreements with other countries. The latter, surely, is an astonishing suggestion. It is fully agreed that the claims for a Scottish Division of European Airways and for the right of the Scots to carry out the detailed organisation of Scottish airlines are probably fully justified. The suggestion that any person or organization other than the appointed Government Ministry should venture into the maelstrom of international diplomacy and arrange private international air agreements is alarming. Apparently even six years of war has not taught everyone that strength lies only in unity.

Until the full-scale plans for the Heathrow project, and the final scheme for Scottish aviation interests are made known by the Government, there is every reason why wholesale and vague comments on the use of Heathrow and Prestwick should be withheld. In the meantime, by all means let us indulge in encouragement and constructive criticism, and lobby for what we honestly believe to be essential for the future of British civil aviation.

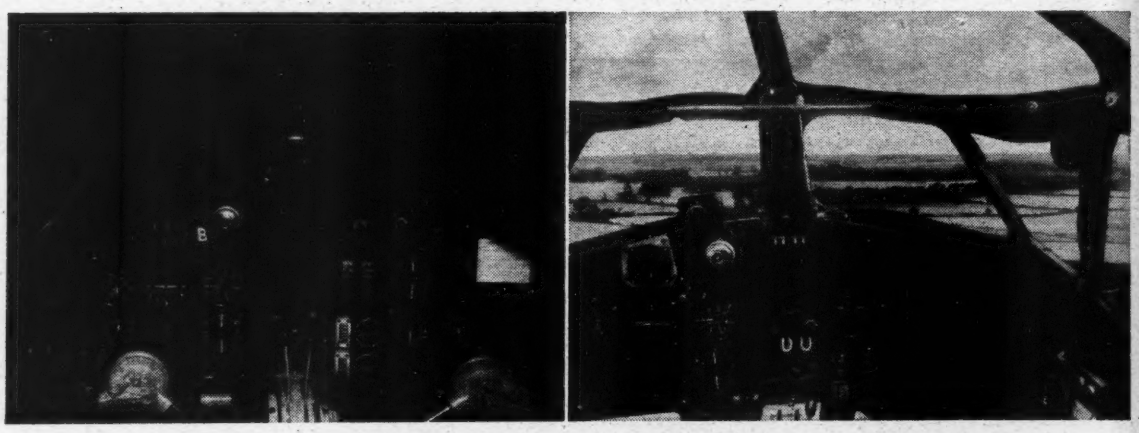
[While we do not agree with everything our contributor says, we feel that his point of view deserves to be stated. No one regrets the need for criticism more than we do, but Heathrow will have to be London's air terminal for many years to come, and it is thus extremely important that no unsatisfactory feature should be allowed to mar it.—ED.]

Night by Day

Semi-synthetic Night Landing and Instrument Flying Training : The "Day-Night" Scheme : Sorting Out the Spectrum

ORIGINALLY developed during the first two years of the war so that the necessary flare-path landing training could be speeded up and its hazards reduced, the "day-night" instructional system is now part of the normal training curriculum of the Royal Air Force. Whereas it was then vitally necessary to devise means by which night-flying training could be continued through the longer and safer daylight hours, the system was found to be so satisfactory, at least for initial training, that it has found its place in peace conditions.

A year or two ago a somewhat similar American synthetic night and instrument training system was described in *Flight*. At that time our own system was still on the secret list, and it was impossible, even for those in the know, to explain that the whole idea had really been borrowed from this country, where it was the direct result of "backroom" work by Sqn. Ldrs. A. W. and C. H. Wood—the former an R.A.F. instructor, and the latter, then in civilian life, a technical photographer.



The inside and outside world as it might be seen by the pupil (left) and the instructor (right) in an Oxford, arranged with the Two-Stage Blue or Amber equipment. With the latter arrangement, the interior would appear blue to the pupil and all outside vision would be removed, while, to the instructor, the interior would appear quite normal while the outside world would be amber-coloured.

Variable Conditions

It should perhaps be explained immediately that the untidy compound word "semi-synthetic" is used in the subtitle for a reason. Unlike the methods of training which have variously appeared with the adjective "synthetic," "day-night" flying training, though only imitative, as the case may be, of night or instrument flying conditions, is carried out in the air and is, therefore, only partially synthetic. In fact, and for all practical purposes, the conditions which can be provided during "day-night" instruction are more useful from the training point of view than any which can be obtained naturally, and they can, furthermore, be modified to suit the particular capacities of and the training stage reached by any pupil. In the ordinary way, it might be necessary to wait many weeks for these conditions. There is, in addition, the considerable advantage of greater safety, since the instructor is not himself flying under night conditions and can probably judge the pupil's aptitude and incipient errors more accurately.

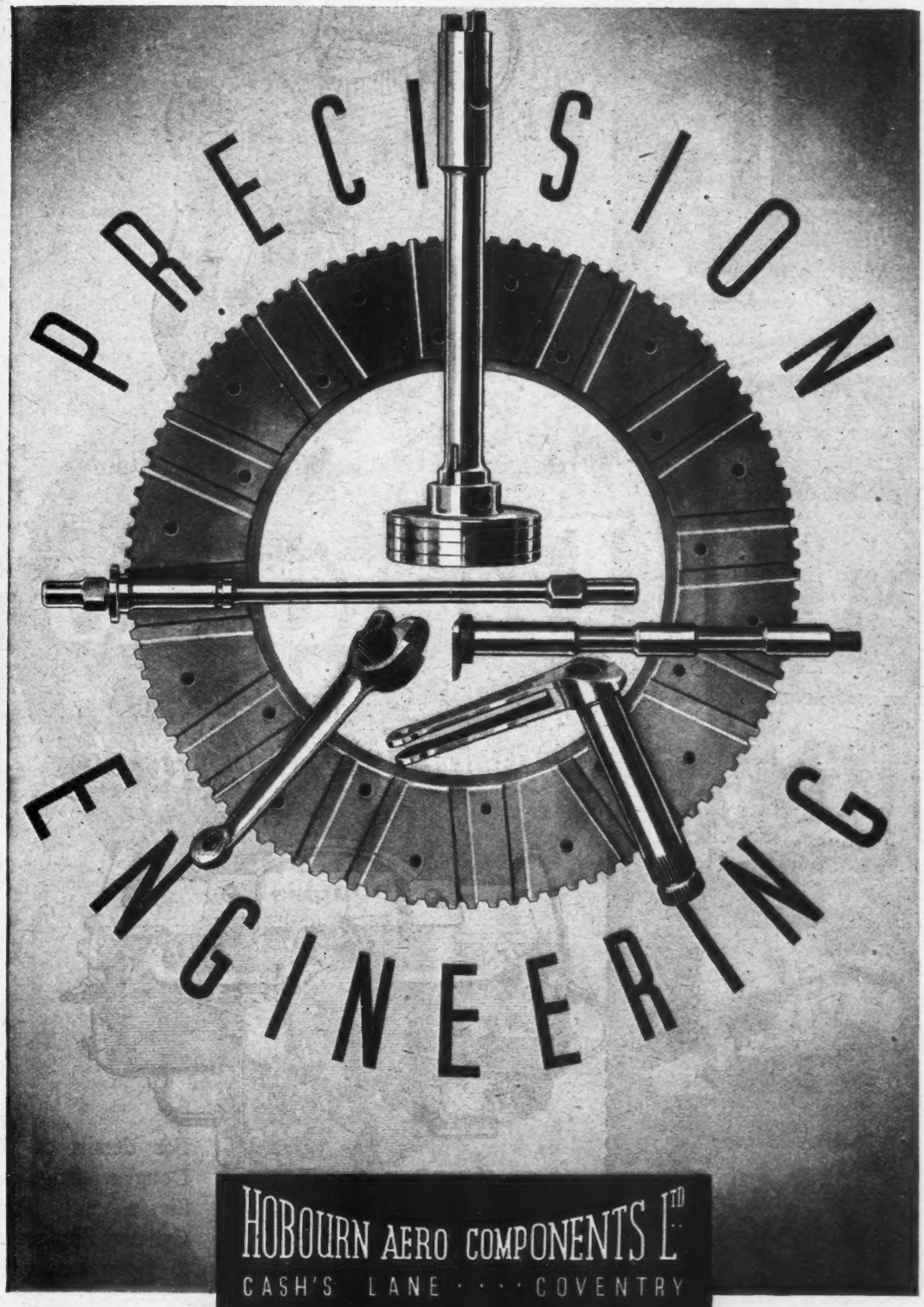
There are four different "day-night" flying schemes in use: (1) The Single-Stage (Flarepath) Scheme, for which the pupil wears special goggles and is only able to see the sodium lamp flarepath and his sodium-lit instruments; (2) the Two-Stage (Flarepath) or Two-Stage Brown Scheme, in which all but the light from the flarepath and instruments are cut off in two stages for the pupil; (3) the Two-Stage Blue Scheme, in which the aircraft is fitted with pale blue screens and the pupil wears amber goggles; and (4) the Two-Stage Amber Scheme, in which the colour positions are reversed. Schemes 3 and 4 are used solely for instrument-flying and night-navigation training.

Before enlarging on the features and objects of the four different schemes it will be as well to deal, first, and as simply as possible, with the basic principles. As everyone knows, normal daylight is made up of a combination of colours which can severally and collectively be cut off by the use of filters of different colours. For instance, the use of a green filter prevents any but very small proportions of the other colours from reaching the eye. In the same way, two separate filters may be superimposed so that one will cut off certain colours, while the other will deal with some or all of the others. By suitable experimentation it is possible to develop two filters which, though giving adequate working vision when used separately, will also entirely cut off all visible light when they are superimposed.

Complementary Filters

Two such "complementary" filter colours are blue and amber. Whereas the particular type of blue used in the "day-night" scheme will cut off all but the red, green, blue and violet of the spectrum, the amber will cut off all but the orange and yellow. At the same time there is adequate visibility through each of the filters for all normal purposes, yet the two together can cut off almost the entire spectrum.

This fact forms the basis of schemes 3 and 4 designed for instrument training. With the Two-Stage Blue system the aircraft screens, side-windows and roof are covered with blue filter material, while the pupil's goggles have amber filters. The instructor is able to see the outside world normally, though with a bluish tinge which soon becomes familiar, and the pupil is able, since unfiltered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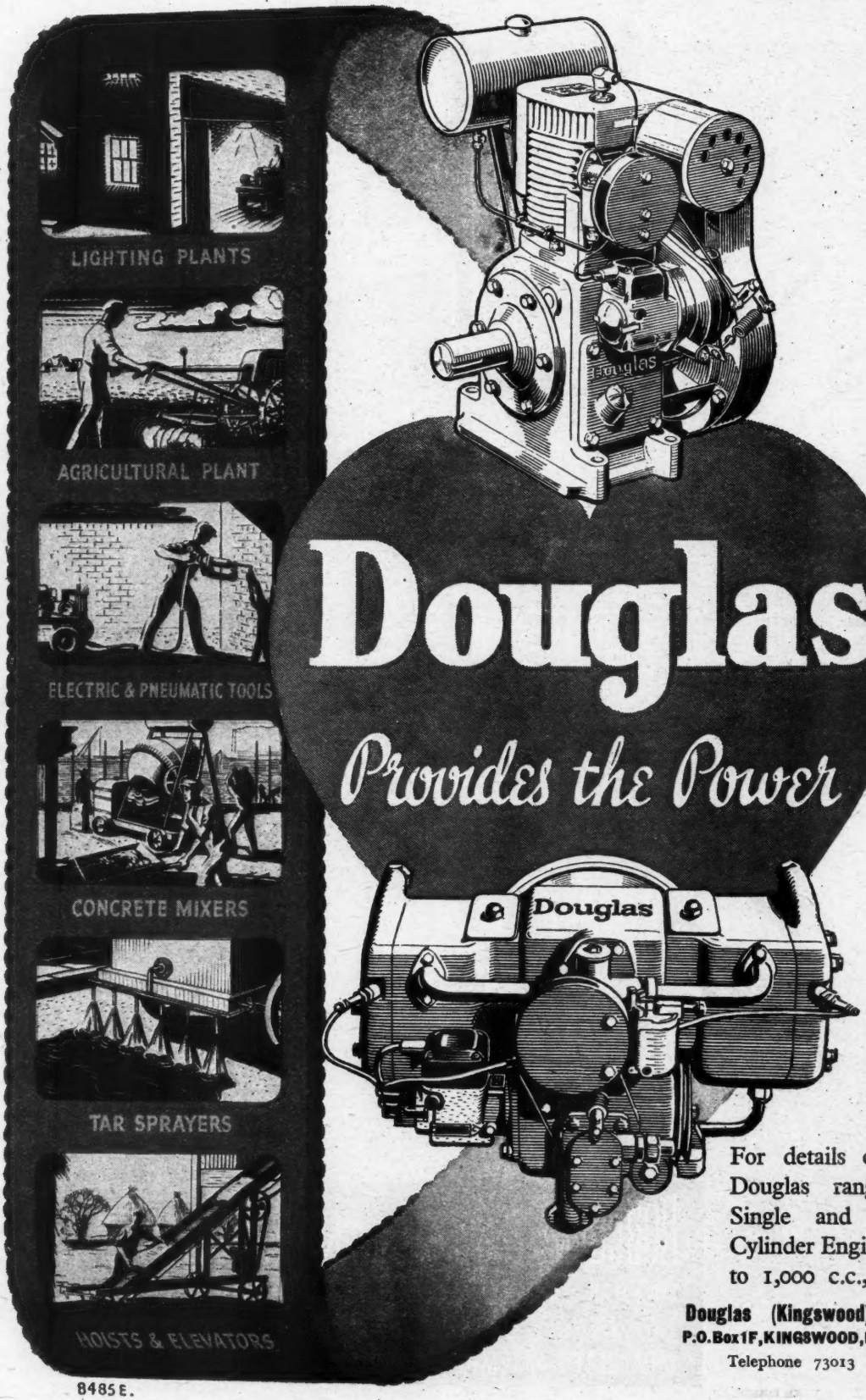

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NIGHT BY DAY

daylight is available for interior illumination, to see all the instruments and controls but has no appreciable vision beyond the blue windows. In the Two-Stage Amber scheme the positions of the colours are merely reversed, though the spectroscopic properties of the colours actually used differ considerably, for very good reasons, from those used in the Two-Stage Blue scheme.

The amber screen scheme is now being standardized, since the use of this type of filter for the screens gives the instructor improved visibility in typical English weather conditions, and is not quite so prospectively depressing during long periods of flying.

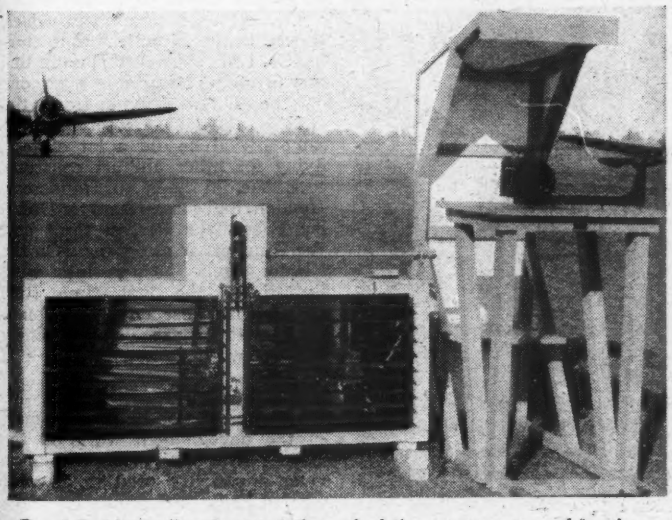
The blue screen is more suitable for semi-tropical conditions in which the natural visibility is good and in which amber might produce an unbearably "hot" psychological effect. One slight advantage of the blue scheme is that the pupil is better able to read maps during "night" navigation exercises through his amber filters than through his blue filters. In each case the screen colours have been carefully adjusted so that the green and red Aldis or Very signal lights can be seen correctly by the instructor.

One of the two types of goggles worn by the pupil for Single-Stage Flarepath training. The latest version has improved ventilation and a weight-reducing headband. A hinged supplementary filter and a sun shield are incorporated.

These two schemes have been dealt with first because the theory of their application is more easily explained and understood, but the original "day-night" system for flarepath landing practice has been that most used and useful for night-flying training. In this Single-Stage scheme use was made of particular properties of sodium-vapour lamps which emit an almost entirely monochromatic light between the orange and yellow bands.

By using a special filter—which may be approximately described as being a compound of greenish and reddish browns—all the colours in the spectrum except that emitted by a sodium lamp can be held up, yet this particular light can be seen through the filter in almost its natural brilliancy. If the pupil wears goggles in which this special filter is used, and if the instrument board and controls can be lit by a sodium-vapour lamp, he will see only these instruments and controls and the sodium flarepath. Consequently he will, in effect, be flying in pitch-black outside conditions relieved only by the lights of the flarepath. The instructor, meanwhile, is able to see quite normally and can carry on with instruction in weather which might be quite impossible during genuine night-flying operations.

The normal arrangement of the sodium flarepath consists of eight lamp units, six of them facing the direction of approach, with duplicates at each end turned at right angles to the others to give the pupil an indication of the position of the flarepath while making a circuit. Since coloured approach-indicator lights cannot be seen through the pupil's filter, special arrangements have to be made to give him the necessary approach-angle guidance. A sodium lamp at the approach end of the runway is fitted with a series of shutters which can be mechanically set in motion to give signals which can best be described as quick-dot or slow-dash at the wish of the operator. This operator watches the approaching aircraft through a grid-wire sighting device which tells him whether it is below or above the correct approach line. If it is below the line he signals quick-dots and if above he signals slow-dashes.



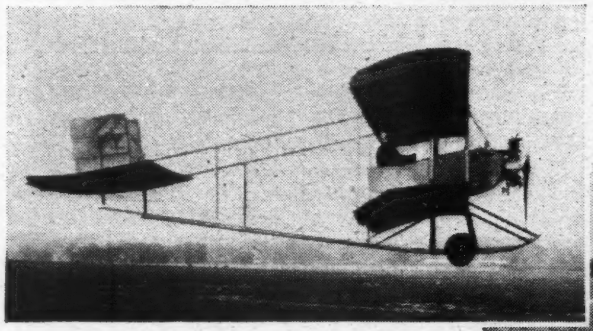
Signal-flashing sodium lamps at the end of the runway are used to give approach guidance since the pupil is unable to see normal colour lighting during his flarepath training. Operator's aircraft sighting table on right.

Practical Limitations

The Two-Stage (Flarepath), or Two-Stage Brown scheme, might have had a wider application had it not been for the fact that the filters must necessarily be of too dark a shade to be used separately for normal flying. Consequently, it is applicable only to tandem-seater aircraft—and it is just these aircraft for which the Single-Stage scheme cannot be applied because of the weight of the equipment necessary for instrument lighting. This system—in which the dark green screen (in a light-proof canopy) is seen through red-filtered goggles to produce the all-but-sodium black-out—was, in fact, the first to be demonstrated in the early days, but its limitations caused its development to be put on one side. With the normal amount of natural light directed through louvres in the canopy, the pupil can see the instruments through his red goggles, but is, through the screen, unable to see clearly anything other than the flarepath.

For peacetime training the one outstanding advantage of the scheme—and apart from any cost or risk considerations—is that, by using different combinations of filters, the effective outside darkness can be modified to suit conditions of training. These combinations must also, of course, be varied to suit different weather and seasonal light conditions. Since it would obviously have been unsatisfactory to allow all the different training units to carry on without supervision and help—and while possibly failing to make the best use of the system—all development and supervision work was handed over, at the end of 1942, to the Empire Central Flying School. Here, instructional methods and suggestions are checked and special explanatory courses are given by the Day-Night Section.

Britain's Test Pilots



The little 35 h.p. Caudron on which Capt. Broad learnt to fly compared with the Tempest II which he flies to-day.

No. 2. CAPT. H. S. BROAD,

Senior Production Test Pilot, Hawker Aircraft Co.

FOR sheer wealth of flying experience it is doubtful whether there is another pilot in the world to equal Hubert Broad. He has flown everything from diminutive single-seaters to multi-engined bombers, and including a number of out-and-out racing aircraft. His log books, of which he has filled some nine or ten, total over 7,500 hours' flying time and 182 separate types. These are honest types—not modifications or different mark numbers of the same aircraft. Many of these he has also flown as seaplanes. Broad, at the age of nineteen, learnt to fly at the Hall School of Flying at Hendon in 1915. The aircraft on which he made his first flight (there was no dual, a pupil did straights across the airfield until he felt it was safe to do a circuit) was the single-seater Caudron with 35 h.p. Y-type Anzani engine. Believe it or not, with this tiny horsepower the Caudron occasionally was made to stagger into the air with two people on board, but the passenger had to sit on the wing by the side of the nacelle.

Early Days

The end of 1915 found Broad in the R.N.A.S. at Eastchurch, and he was on the very first course at Cranwell, which was then a R.N.A.S. establishment rejoicing in the name of *H.M.S. Daedalus*.

His first tour of duty at the front was with No. 3 Squadron at Dunkirk. He was among a number of pilots lent by the R.N.A.S. to the R.F.C. No. 3 Squadron flew Sopwith Pups, and it was while he was on one of these, escorting a bombing raid by 90 h.p. R.A.F.-engined B.E.s, that he was shot through the neck by one of Richtofen's later Goering's—Red Circus pilots.

On recovery he spent a while as an instructor at Chingford and then went for his second tour of operations with No. 46 Squadron, who flew Sopwith Camels. The end of the 1914-18 war found Broad instructing at the Fighter Pilots' Flying School at Fairlop.

Peace found him, as it found so many other young fellows, with the ability to fly aircraft superbly and no other means of making a living. But a good living could be made by joy-riding in the early 1920's. First he joined the Avro Company, who were running joy-riding in a fairly big way, and in 1920 went to the Adiron Lakes in America with two Avro 504 seaplanes. These two aircraft saw their last days in Long Island, where they were completely wrecked by an autumn gale.

Capt. Hubert S. Broad, M.B.E., A.F.C. A photograph taken at Langley a few days ago.

By the next year he was back in England competing in the Aerial Derby air race round London on a Sopwith Camel. He finished 6th. In October, 1921, Broad joined de Havillands. Those who know this great concern now will smile to learn that when it started in those days it consisted entirely of two fabric hangars and a hut at Stag Lane. If memory serves, the capital of the company at that time was £100.

The D.H. series numbers, which started in the Aircraft Manufacturing Co. Ltd., were carried on in this new firm, and Broad flew every one of the D.H. designs from the D.H.27 to the D.H.90. In the same period he did a lot of test-flying for other aircraft constructors. He did the W.10, Handcross, Hendon, and some others for Handley Pages, the Parnall Pipit and the Saunders A.10 fighter. On the Gloster Grebe he ran into wing flutter for the first time (this trouble, in those days, was on a par with the compressibility troubles we have now).

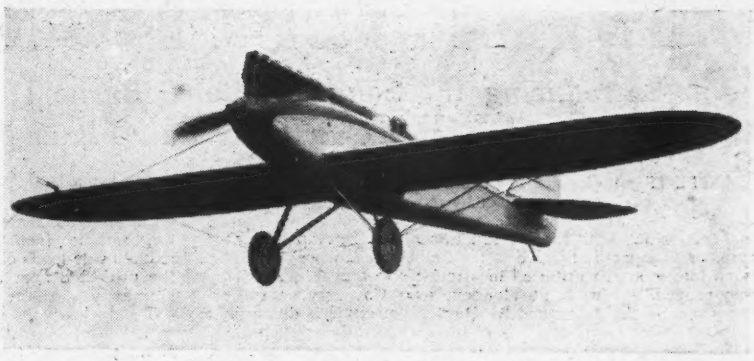
Seaplane testing

Another big job he did was most of the development work on the Gloster II and III racing seaplanes. Over a period I used to go with him to Felixstowe regularly. As a Press man I was forbidden the precincts of the R.A.F. seaplane station, but there was a perfectly

good Great Eastern Railway pier alongside the station. I used to climb over the fence and watch the proceedings from the pierhead. Broad nearly lost his life there one day in October, 1924. As he was landing the Gloster II a forward strut to the floats collapsed, and the aircraft turned completely over. Mrs. Broad was watching from the shore, and it seemed a very long time before Hubert appeared on the surface.

In 1925 Hubert Broad flew the Gloster III racing seaplane in the Schneider Trophy contest which was held that year over Chesapeake Bay in America. This was the race in which Henri Biard, flying the Supermarine S.4—the true forerunner of the Spitfire—crashed in the water with wing flutter. Broad finished this race second to Jimmy (now General) Doolittle. That must have been a vintage generation, because many names from that period have found their way into the high-spots of this last war.

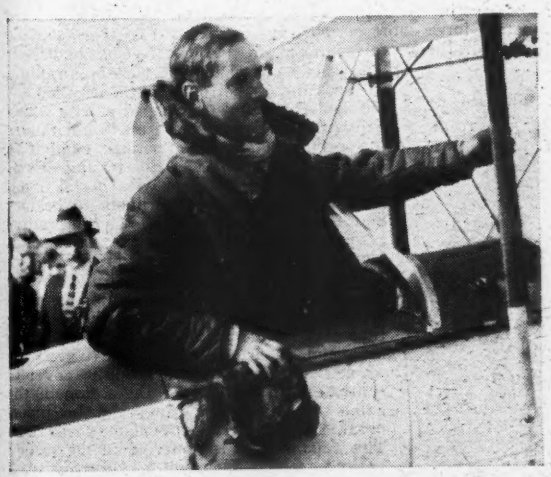
With the advent of the D.H. Moth in all its variants, Broad was to be seen performing aerobatics at most flying-club meetings and entering many of the races. These included the King's Cup Race, which he won in 1926. He was flying a delightful Cirrus I Moth, which was a study in ivory and red. His average speed over the whole 732 miles was 90.4 m.p.h. His *pièce de résistance* in aerobatics was a perfectly formed big loop, the base of which was only some 150ft from the ground. It was a joy to behold, but very dangerous to perform. Broad had sufficient sense to realise this and sufficient courage to stop doing it.



The little D.H. Tiger Moth monoplane which had a top speed of over 187 m.p.h.

"Hooked"

It was during an aerobatic show that Hubert had his closest shave in a life packed with incident. And it was so simple. Flying a D.H. Tiger Moth with no one in the front seat, he did a slow roll—a stunt at which he was a master. The safety belt in the empty cockpit was loosely done up. While the Moth was inverted the belt hung down and, as the aircraft turned the right way up again, the belt came back *over* the joy-stick. The result was that Broad had only about 1½ inches of stick movement; but, nothing daunted, he made a sort of tail-up, seaplane landing. In this connection it is to be remembered that there were no lovely 2,000-yard runways on which to do this sort of thing. In those days there was not a single runway available in Britain; not even for the take-off of over-loaded aircraft for long-distance records!



A day in the life of a test pilot. Broad getting out of a Gipsy Moth which he had flown continuously for 24 hours on August 16/17, 1928. He started with 80 gallons and had 12 gallons left.

Another unhappy moment occurred when he found the tail trim (the incidence of the whole tailplane was adjustable) of a D.H.34 had been connected in reverse. By a good deal of jockeying he managed to get into Northolt. On yet another occasion a careless mechanic left a screwdriver jammed in the chain and sprocket of the rudder-actuating gear. This necessitated a down-wind, cross-wind, finishing up into-wind landing at Hendon airfield, because that was a bit bigger than Stag Lane.

One of the prettiest little aircraft he ever flew was the original D.H. Tiger Moth monoplane. This was tailored exactly to fit Broad. Physically he is not of big stature and few other pilots could get into the machine. In the front of the cockpit was a bulkhead which had two holes just large enough for the feet to be threaded through, and these holes had to be padded with sorbo rubber so that Broad's shins did not get barked while landing and taxying. Springing was almost non-existent. Span was 22ft 6in and length only 18ft 7in.

In August, 1927, on this machine he broke the world's record for light aircraft for both speed and height. For the former the figure was 186.47 m.p.h., he having taken 19 min 59⅘ sec to cover the 10 km, and for altitude he reached 20,000ft in just 17 min. A year later he took two more world's records on the D.H. Hound.

In 1935, after 20 wonderful years of service, he left de Havillands and later did some flying for the Air Registration Board. From here he went to the Royal Aircraft Establishment and finally joined Hawkers to be in charge of all their production testing at Langley. He will be 50 in a matter of a few weeks, yet every day sees him at oxygen height testing Tempest IIs. As he says, he has gone from 35 h.p. in the Anzani to over 3,000 h.p. in the Centaurus and Sabre VI, and from 2½ lb/sq ft in the Caudron to 40 lb/sq ft in the Tempest II. J. Y.

DESIGNER'S FORECAST

A PURE-JET airliner weighing 100,000 lb which would cruise at 500 m.p.h. for 2,500 to 3,000 miles at 50,000ft, was mentioned by Mr. Roy Chadwick as a possible British achievement within about the next four years, when he recently addressed the Old Students' Association at Manchester College of Technicology, where he was a student in 1915-16. There was no reason, he said, why Britain should not have such an aircraft within this period, for we were well ahead of any other country in the world with gas-turbine development.

Flying at 50,000ft would introduce additional pressurisation problems and the cabin blowers would have to maintain a pressure differential of 11 lb/sq in. Tests on the Avro Tudor I had shown that the structure would hold this pressure, but there were problems which still had to be solved in connection with the openings in the fuselage.

Mr. Chadwick thought it probable that wing loadings would go up to 70 lb/sq ft but the resultant higher take-off and landing speeds would be looked after by the large runways now being built in all parts of the world. The all-wing type he did not think would be an important factor for some years.

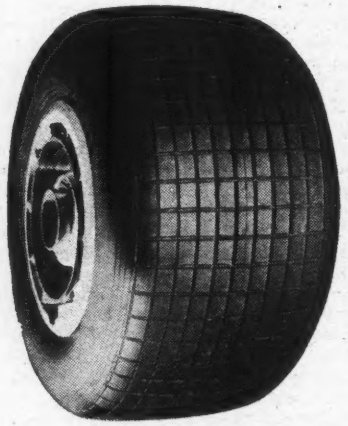
Tyres for To-Morrow

Introducing the Squat Dunlop : Brake Testing in the Grand Manner : Gun Gear and Flame-proof Pipes

ARTISTS who depict "air liners of the future" like to give scale to their subject by representing undercarriages of juggernaut aspect, towering above stupefied onlookers. Now, with the introduction of the Dunlop "squat" tyre, or Compacta, to give it its trade name, wheel diameter is no longer a true criterion of aircraft size and weight. This was proved last week at Honiley, near Coventry, where an experimental flight manned by Dunlop personnel is doing final tests on the new tyre and on advanced types of aircraft brakes.

The essential merit of the squat tyre is its greatly reduced diameter by comparison with a normal pattern of equivalent pressure and capacity. This means easier stowage in new aircraft with thin wings and closely spaced spars. In other designs it will preclude bulging the nacelle.

A typical tyre of normal form at 90lb pressure has a diameter/width ratio above 3.25. For "wheel-less" low pressure tyres, as used for tail wheels, a ratio of 2.5 is common but disallows adequate brakes. The use of twin wheels on a common leg, favoured in America and Germany, is an attractive solution if a single leg is permissible, but in any case the squat tyre offers important advantages. Although the wheel with this tyre is lighter than a normal wheel it is rather heavier than equivalent twin wheels (all wheels at the same pressure), but for a true comparison the whole undercarriage must be considered and the squat-tyre undercarriage assembly is the lightest.



The "squat," or Compacta tyre (left) should prove a real boon to designers of large aircraft as suggested by the view of the Lancaster used for tests.

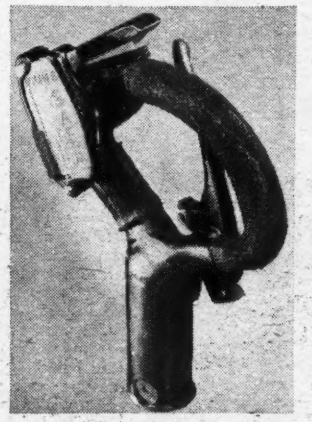
A Lancaster is flying at Honiley with two of the new tyres, only 41in in diameter and weighing 488lb each. A normal pattern at 60lb pressure, as used on the Lancaster, is 62in in diameter and weighs 626lb. The Brabazon I is to have two pairs of 65-inch "squats" on single legs.

The diameter/width ratio of the new type is less than 2. The characteristic flat-crown section is achieved by constraining the crown, which would otherwise assume its natural torroidal shape, by binding with synthetic cord. For initial trials a 90lb pressure is being used and tyre life has been found to compare favourably with a normal tyre at the same pressure. Full deflection of the normal tyre occurs at about three times the static load, whereas for the squat tyre the figure is about 2.5. Due to this reduced deflection the total energy absorption is less than normal and some extra leg travel will, no doubt, be necessary, but this apparent disadvantage may permit improvement in certain aspects of shock absorber performance.

As with all new developments of this sort, incidental advantages and disadvantages accrue. The reduced rolling radius, for example, increases brake power for a given torque and reduces side loads on the moving assembly; on the other hand, the projected area is slightly greater than for single or twin normal tyres at the same pressure.

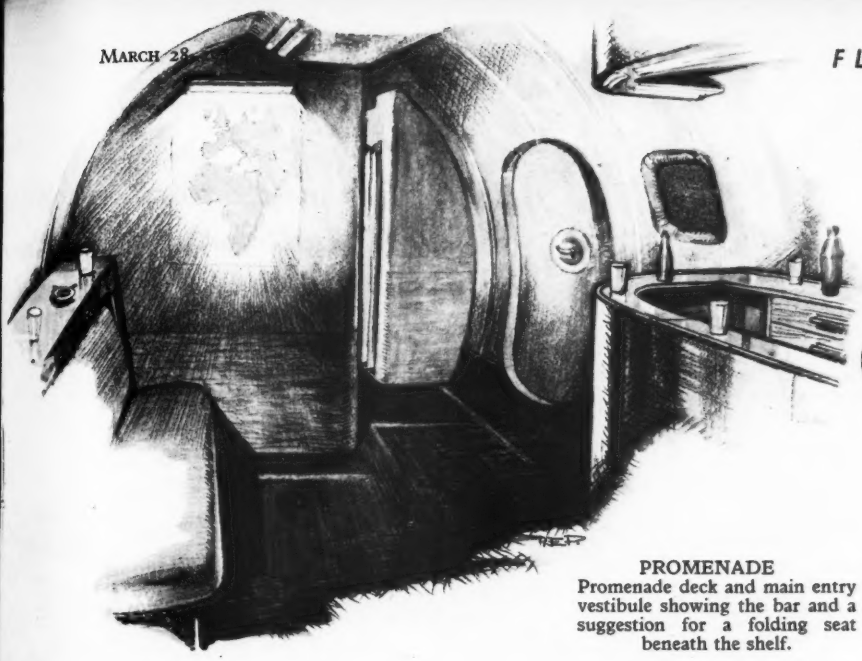
The real advantages of the squat tyre are chiefly apparent to the aircraft designer and could not be perceived from the Honiley control tower when Mr. Sutcliffe, the Dunlop test pilot, landed a Lancaster to demonstrate the effectiveness of the latest brakes as applied to the new tyres. A cross wind of 20 m.p.h. did not prevent his pulling up in about 350 yards from touch-down, though usually, he said, the figure is more like 300 yards. He also flies an Albemarle which, with its tricycle undercarriage, lends itself well to demonstration; this he stops in 250 yards or less. A Meteor and a Lincoln will eventually complete the Honiley "stable."

Brake testing on massive flywheels is one of the more spectacular sides of research, but the proving of the new flame-proof flexible pipes seems even more stringent. The company put in a great deal of work in developing the new pipes. Even now that fire extinguishers have been so highly developed it is necessary, in the event of an induction fire, for the engine to function for a short period during which the airscrew can be feathered, the petrol switched off and the fire extinguished. The usual type of flexible hose fails rapidly if exposed to a petrol fire in a nacelle, but Dunlop's have now developed a pipe which will withstand an engine fire without failure for sufficient time to permit combative measures to be taken. For testing one of the new pipes it is filled with petrol or oil at the maximum pressure likely to be met and bent to its minimum bending radius before being subjected to the flame of a blow-lamp at about 1,000 degrees C.



The "Selectric" gun firing control with its safety flap. The next development is a "streamlined" model for catapult-seat aircraft.

Two types of hose have been developed; the more popular is a wire-reinforced high-pressure type comprising a synthetic lining tube over which is braided successive layers of cotton, high-tensile wire and cotton, the whole being finished with an outer cover of synthetic rubber to resist the action of the flame. Asbestos braiding can be incorporated further to improve flame resistance. This type of hose is preferred to the second variety, which incorporates heat-resistant cotton and materials like glass fibre and asbestos, because it is possible to maintain a smaller outside diameter for a given bore size. It has the disadvantage of weighing more.



PROMENADE
Promenade deck and main entry vestibule showing the bar and a suggestion for a folding seat beneath the shelf.

DESIGN for COMFORT

The Avro Tudor II: A Notable Contribution to Britain's Civil Air Power

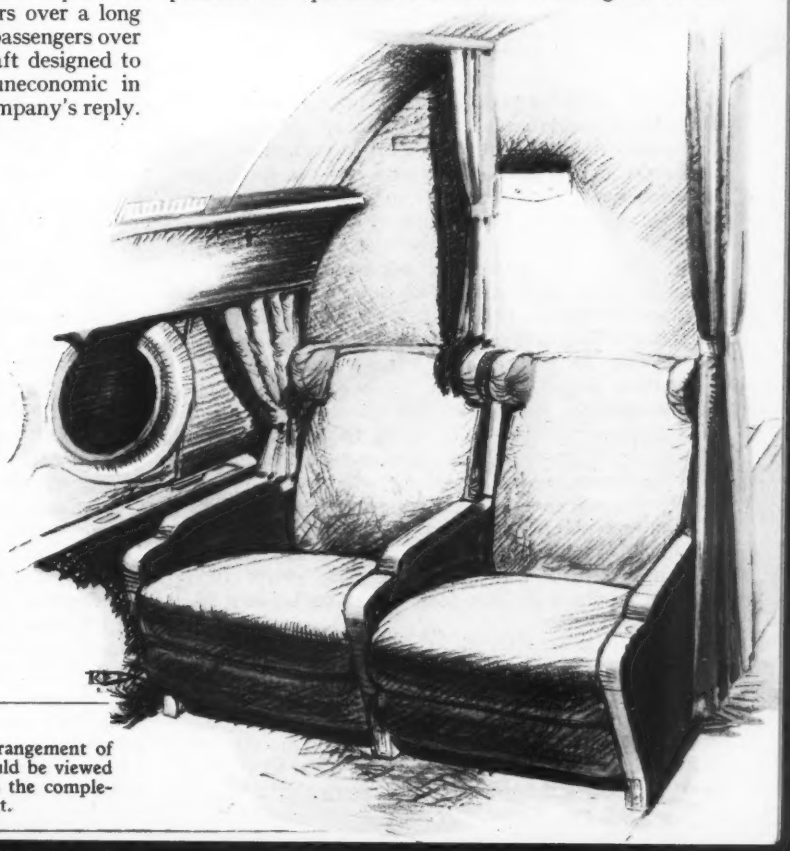
By C. B. Bailey-Watson

A DETAILED survey of the Avro Tudor I appeared in the June 28th, 1945, issue of *Flight*, and, because the Tudor II with which we are now concerned is basically a Tudor I with a much larger fuselage, it is felt that there is no real need to recount the details of the structure. Suffice to say that it is identical with that of the smaller Tudor, and is, probably, the simplest and lightest structural form possible for the job.

It might, however, be of interest to reveal why we have two distinct aircraft with the same type-name. Originally A. V. Roe and Co., Ltd., were asked to prepare a design for a machine capable of transporting a small number of passengers over a long range or, alternatively, a large number of passengers over a short range. Quite obviously, an aircraft designed to fulfil both these conditions would be uneconomic in operation, and such was the gist of the Company's reply. As a result, the decision was taken to have two aircraft, one with a large fuselage, the other with a small one, and to use the same wings, engines, tail surfaces, etc., for each. Hence we have the Tudor I to carry up to 24 passengers a distance of over 4,000 miles, and the Tudor II to carry up to 60 people for a distance of about 2,000 miles. Both are equipped with a cabin atmosphere conditioning system, and the all-up weight and performance (other than range) is about the same for each.

It is with the Tudor II that we are here concerned, and although an accommodation plan of the short-range 60-passenger version is included to illustrate the capacity available, it is in the normal B.O.A.C. version that it is felt most readers will be interested.

This model is laid out to an accommodation standard of 40 day passengers/20 sleepers. Before going further, the observation might be made that the ultimate would logically seem to be the provision of both a day aircraft and a night sleeper aircraft, each a special machine for the job. If such were laid on as shuttle services between given stages, the traveller could spend the day in a comfortable chair, leaving it in the evening for a dinner at the airport hotel, and then, if he wanted to press on, go to bed in a sleeper-special for the night journey. Alternatively, he could spend the night at the hotel and continue his flight on the morrow in a day aircraft. This is likely to be the system adopted in the end, and the sooner such facilities are planned for operation the better. So long as we are



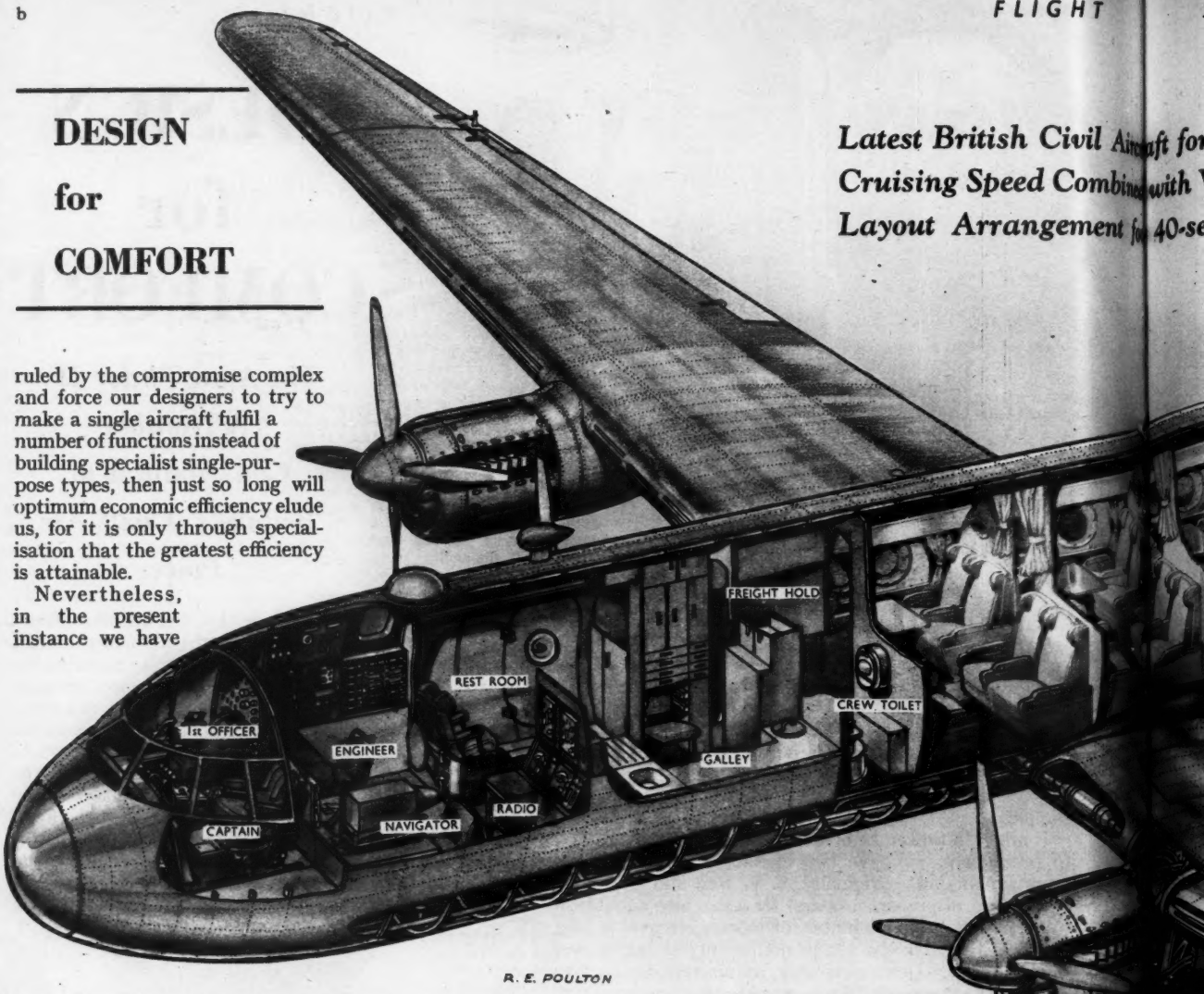
DAY CABIN
Vignette of day seating showing possible arrangement of curtains, lighting, etc. This illustration should be viewed in relation to its companion which indicates the complementary night sleeper arrangement.

DESIGN for COMFORT

Latest British Civil Aircraft for
Cruising Speed Combined with
Layout Arrangement for 40-se

ruled by the compromise complex and force our designers to try to make a single aircraft fulfil a number of functions instead of building specialist single-purpose types, then just so long will optimum economic efficiency elude us, for it is only through specialisation that the greatest efficiency is attainable.

Nevertheless, in the present instance we have to consider existing plans for the Tudor II and, whilst admitting the accommodation standard decided upon, the manner of its execution is open to argument. This is no reflection on A. V. Roe whatsoever; so far as they are concerned, the customer (in this case B.O.A.C.) must be allowed the prerogative of "rightness."



R. E. POULTON

Firstly, we might survey the aircraft as affording a given volume in which the accommodation can be arranged. The main entry door is on the port side aft and opens into a promenade deck. Rearward of this are the ladies' and gentlemen's toilet rooms, wardrobe space and stowage for passengers' hand baggage. The promenade deck embodies a bar in the port forward corner, this becoming a bureau for the purser whilst on the ground; additionally, a shelf along the starboard wall, with windows above, allows the passenger to lean there with his drink whilst watching whatever is passing below. In our revised interior arrangement scheme a folding, four-place bench seat is incorporated beneath the shelf so that people not wishing to stand can enjoy the atmosphere of the prom. ade deck whilst sitting. When not required, the seat would fold away flush beneath the shelf.

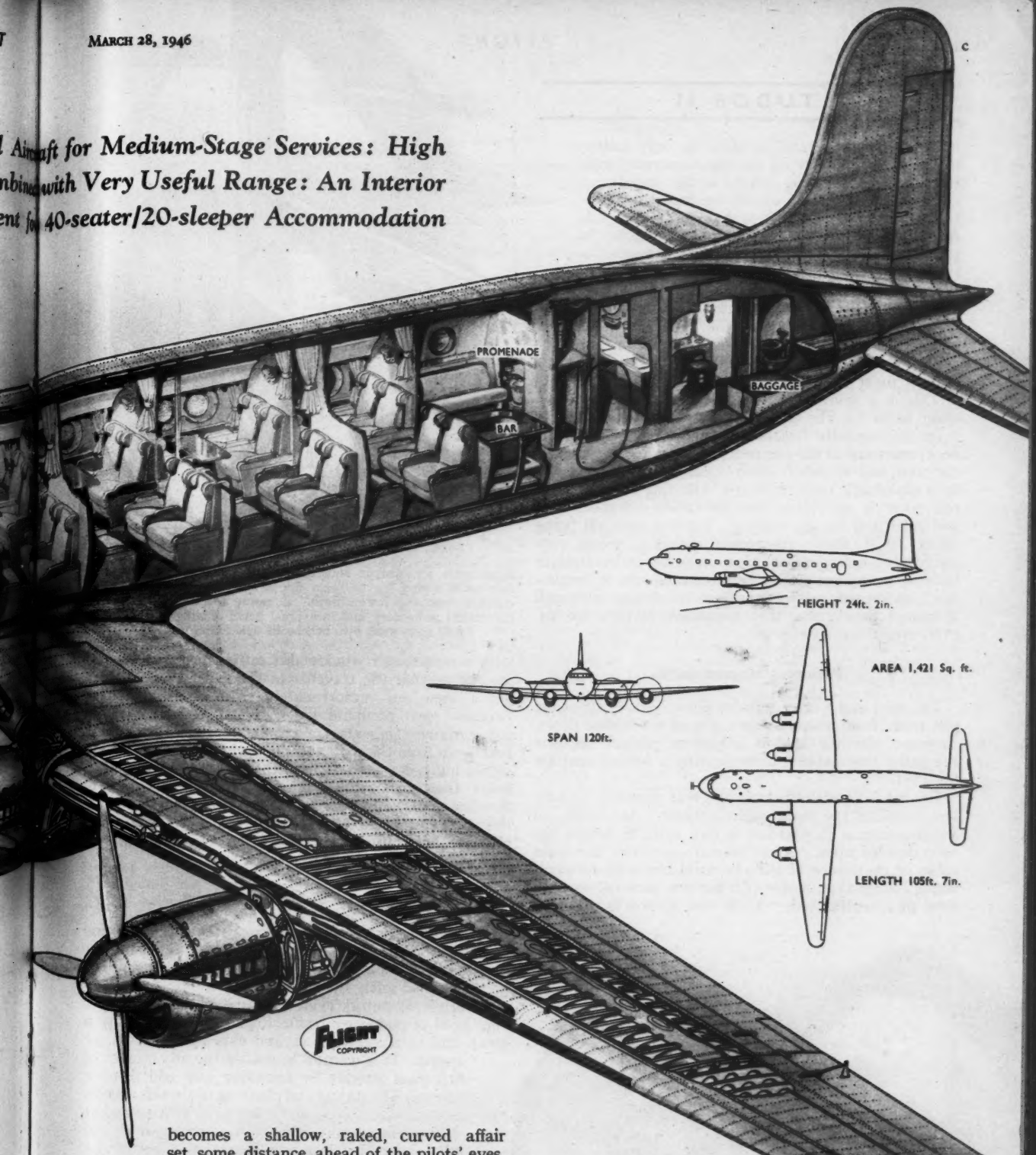
For flights of lengthy duration, the promenade deck, where one can go and stretch one's legs and/or have a drink at the same time, is a most valuable feature. Being forced to sit in a chair for perhaps ten or twelve hours through lack of alternative, is to impose a monotony upon the passenger, and may tend to make him rebel against air travel. Something more than sheer speed of transit must be offered. The promenade deck is a worthy step in the right direction.

Up forward, the flight deck is well arranged, the layout being similar to that used on the Tudor I. On the larger aircraft, however, the captain and first officer are provided with offset control columns with "elbow" cantilever arms carrying the "spectacle" wheels for aileron control. The whole instrument panel is flexibly mounted, and each pilot has his own set of blind-flying instruments, these being separated by a central group of instruments comprising radio-altimeter and limit switch, homing indicator, and undercarriage position indicator. Beneath these are the engine-speed indicators and boost gauges—the latter calibrated in inches of mercury instead of the more usual British practice of lb./sq. in.

The control cabin layout

Finalising of control and instrument arrangement to the likes and dislikes of the "customer" is apparently by no means an easy job. So many people have different ideals. However, the control cabin layout of the Tudor II is good, and features which one pilot might argue against might equally well be argued for by another pilot. There is a point though, in such an aircraft as this, which is of vital concern to all pilots—field of view. Pressurisation makes a large screen out of the question; drag militates against a flat, upright screen, and so the screen

...ft for Medium-Stage Services: High ...with Very Useful Range: An Interior ...40-seater/20-sleeper Accommodation



becomes a shallow, raked, curved affair set some distance ahead of the pilots' eyes. This is the tendency in almost all modern civil aircraft and it is not peculiar to the Tudors by any means.

The flight engineer is stationed behind the first officer and sits at his very comprehensive panel facing forward. Throttles for pilots and engineer are interconnected, and the friction locks are so arranged that the pilot can override the engineer's settings if necessary. Engine-speed controls are, however, not duplicated; the pilots have a single master lever by which the required revs. can roughly be selected, and the engineer is provided with individual controls for accurate separate setting. All engine and auxiliary service instruments and controls are

THIS special introspective drawing by R. E. Poulton illustrates the essential structural form of the Tudor II whilst showing, at the same time, the excellent layout of the flight deck and arrangement of passengers' services. The planning and provision of the accommodation shown is, however, a suggestion and should not be regarded as a factual illustration, since the final interior design has not, as yet, been decided.

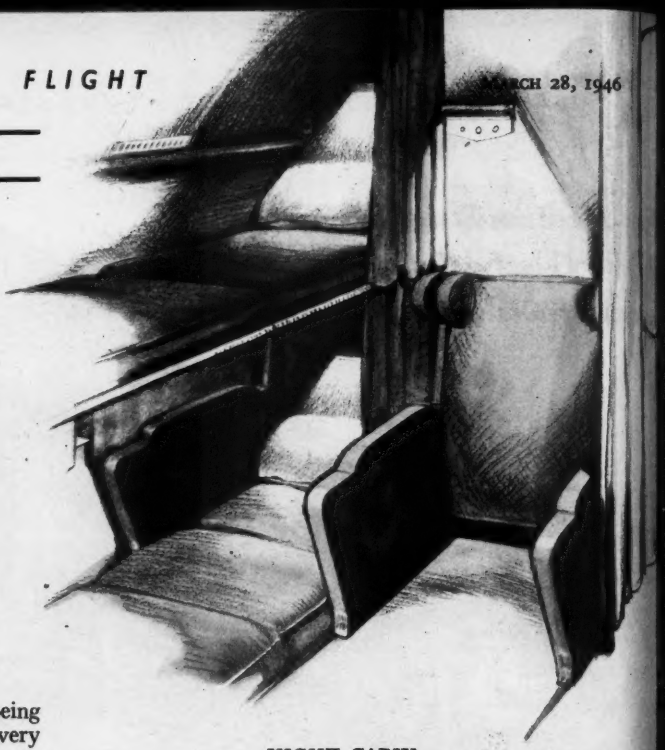
TUDOR II

under the engineer, and, in fact, the only instruments on the pilots' panel are those concerned with the actual manœuvring control of the aircraft.

Navigator and radio officer are seated back-to-back on the port side, aft of the pilot, and each is furnished with the latest standard equipment. In this connection, the navigator has "Rebecca," a radar device by means of which he can give directions to the pilot over the intercomm. and so "talk him down" for landing in thick weather.

Aft of the radio officer is the galley, a fully equipped compartment with sink, refrigerator, hot cupboards, ice-cream container, etc., whence passengers' inner wants may be satisfied. Rearward of this is a small toilet complete with folding wash basin for the use of the crew.

On the opposite (starboard) side of the flight deck, rearward of the engineer, is a rest room for the crew, and 40 cub. ft. of its volume is taken up by a diplomatic mail cupboard. Opening into the rest room is an access door for crew's entrance, and mail and freight loading; but the door sill being about 16 ft. above the ground makes it a not very convenient arrangement. Until tricycle undercarriages become a uniform mode, the inconveniences of "orthodox" undercarriages will continue to obtain—although it cannot be claimed that nosewheel layouts are entirely free from drawbacks.



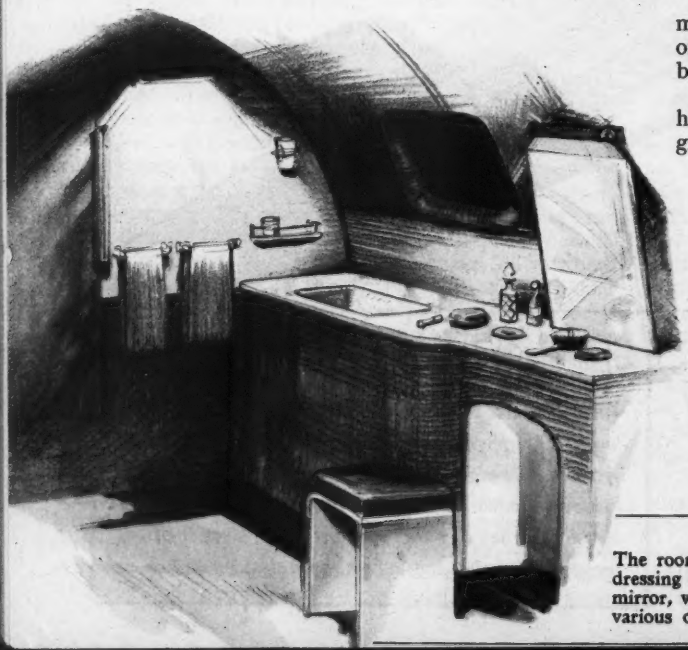
NIGHT CABIN

Suggestion for sleeper accommodation showing how "wall" seat-backs swing up to form upper berth, and "aisle" seat cushions make-up lower berth. Dressing space is provided by the vacant aisle-seats, and individual berth reading lights would fold away flush into bulkheads when not required.

Passenger accommodation

The mail and freight hold of 175 cub. ft. is aft of the rest room, from which access is gained via folding doors. Recessed into the hold is a kitchen cabinet opposite the galley, the cabinet incorporating a folding seat for the chef.

Having dealt with the front and rear planning, we may now consider the main cabin volume. As stated, an accommodation standard of 40 day seats/20 berths has been decided upon. As at present conceived, the main cabin of the Tudor II is to be furnished with forward-facing, bench-type seats, each for two persons, on both sides of a central aisle. Each seat station is provided with a rectangualr window, set rather far forward, the idea being that the traveller in the inside position can get a view out—unfortunately this means that the "corner" seat occupant has to crane forward to look out. Above the seats are tubular-frame berths which fold down from the roof, and the backs of the seats themselves hinge-down to form, with the seats proper, the lower berths. Curtains are the proposed means of dividing upper and lower berths, end from end and from the aisle; and whilst one can accept the latter condition, the end division by curtains can be said to be capable of improvement.



LADIES' ROOM

The roomy, pleasantly finished ladies' dressing room is furnished with a long mirror, wash basin, dressing table and various other necessary appointments.

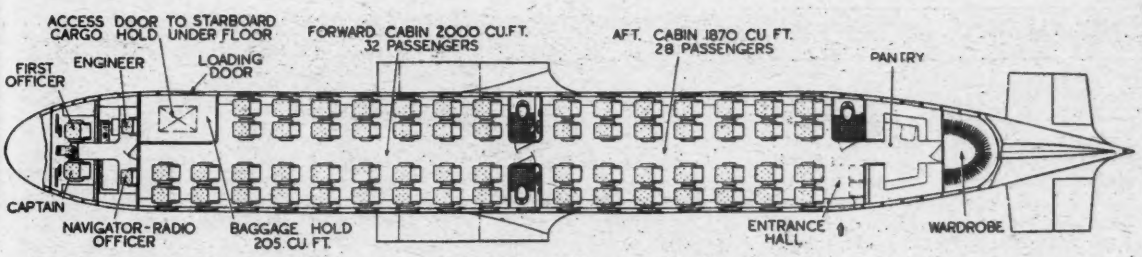
Importance of passenger appeal

This, briefly, is the proposed arrangement of accommodation for B.O.A.C. Tudor II's. By day, serried ranks of seats in a long "tube," by night a honeycomb of berths divided solely by curtains.

If airline operators ever seriously hope to attain a high level of passenger traffic, then they *must* devote a great deal of thought, time, and expense to passenger appeal. It is wanton to nullify the advantages of first-class aircraft by installing any odd interior scheme. The styling and planning of aircraft accommodation is a specialist's job to a greater extent than applies to any other form of conveyance, and the sooner this lesson is learnt the better for British aviation.

The writer makes no specific claim to being a stylist, but he is sensibly alive to the effect on the ordinary passenger of entering a long "pipe" with small windows and ranks of seats. Psychologically, it is inept.

For this reason, in the accompanying cut-away drawing an alternative interior scheme is illustrated instead of that apparently desired by B.O.A.C. The objection to rearward-facing seats is a relic of surface travel.



This cabin plan of the 60-seat day passenger version gives an excellent idea of the fuselage capacity. The modified layout of the flight deck and the ingenious wardrobe are noteworthy features.

In an aircraft one does not get solid objects flashing past the window, and there is virtually no imparted sense of motion. Further, the rearward-facing passenger (in a low-wing aircraft) gets an unobstructed view, whereas his opposite number sees more wing than anything else.

Actually, one soon gets bored with looking out, there is so little to see, but the passenger must be given the sense that he can see a great deal. With pressurization, small windows are a "must," but every effort should be made to give the passenger an illusion that there is far more window area than is actually the case. On the Tudor I the windows are circular and grouped in pairs, with a very clever curved "spectacle" frame enclosing them inside. The effect is that of large area, and each passenger can get a good view without hindrance. This excellent idea has not so far been employed on the Tudor II because the B.O.A.C. interior scheme stipulates forward-facing seats. Nevertheless, I am going to suggest that the planning be revised, and, for this reason, our drawing shows the doubled windows embodied, with a suggestion on how the accommodation could be arranged rather more advantageously.

Individual Compartments

Seats would be individual chairs arranged side-by-side facing fore and aft, four seats to a compartment on both sides of a central aisle. Compartment divisions, as non-structural members, would be of similar corrugated light-alloy sheet, faced both sides, as that used for existing partitioning. Windows, as already suggested, could scarcely be better than the doubled "spectacles" used on the smaller Tudor.

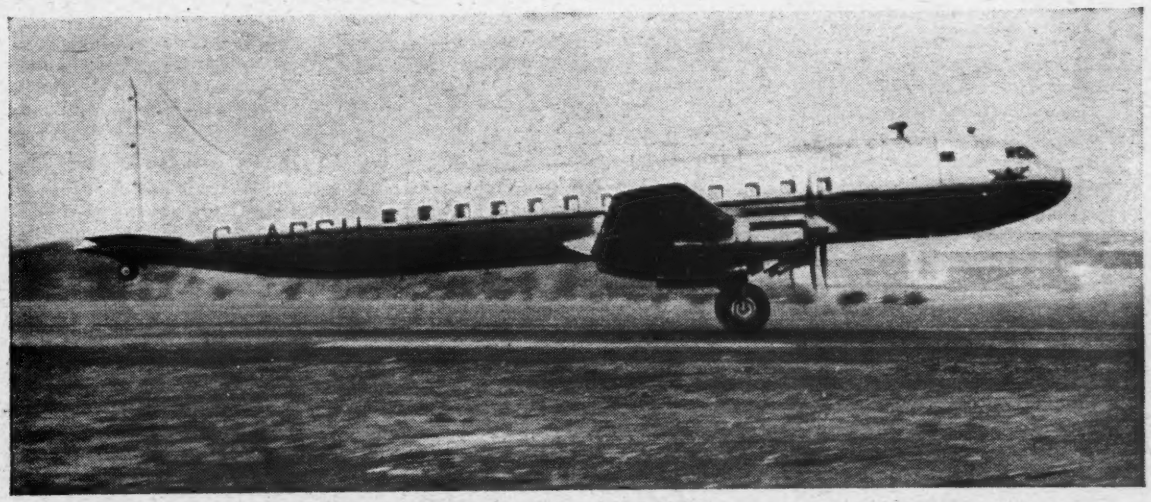
For night travel, the opposed pair of seats nearest the wall could use the seat cushions of their neighbours to fill the space between them and so provide the lower berth. The "wall" seats would then have their backs swung up and joined to form the upper berth, the space normally devoted to the aisle seats so becoming available for dressing, etc. Thus, upper and lower berths are provided by the seating, deleting separate permanent upper berths with a consequent saving of about 400lb. Part of this gain would, however, be negatived by the compartment divisions and by the individual chairs.

Psychological Effect

What would be the general impression on the ordinary passenger entering such a Tudor II? He at once gets a feeling of solidity, then of individual comfort, aided by absence of claustrophobic effect because the paired windows serve a *compartment* and give the impression of large area. Contrast this to sitting in one of a rank of seats, with only a seat-back facing you, and all you can see over that seat back is a long, unrelieved, curved roof surface. You are expected to put up with this for perhaps 12 hours!

It will be appreciated that the suggested interior arrangement provides the same capacity as that of the B.O.A.C. scheme, but even if it did not—even if it meant sacrificing, say, four seats, I suggest it would *still* be worth it on the grounds of passenger appeal. It is the task of everyone in any way connected with British aviation to lift this to the highest level possible. The operators must do everything to encourage ordinary people to fly—whereas by contrast the present tendency appears to be that the person who wishes to fly must prevail upon the operator to let him do so. We shall progress very slowly so long as this mentality obtains.

Certainly, these comments are concerned with policy rather than with the Tudor II as an aircraft; but the mere fact that this particular machine is expected to champion

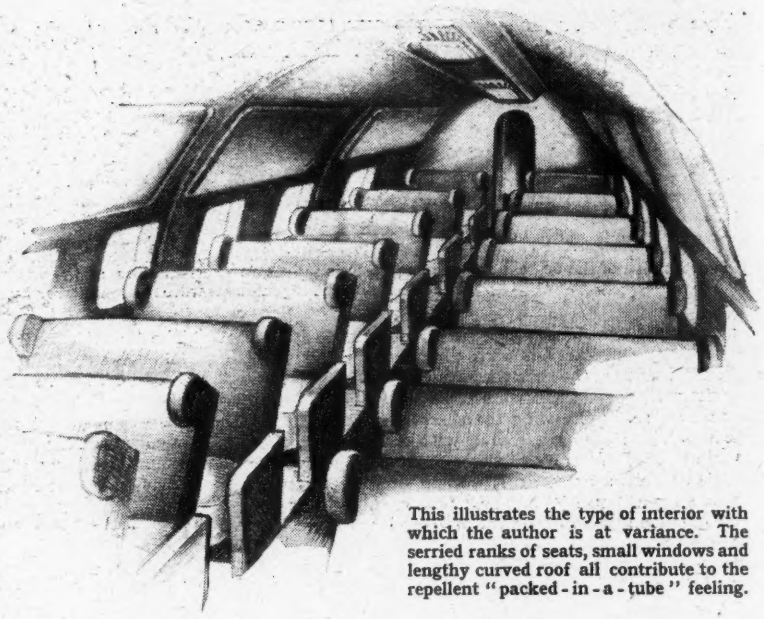


On her maiden take-off the Tudor II makes a fine study of grace expertly compounded with utilitarian efficiency. The initial range of test flights promise a very useful life for this largest Avro aircraft yet.

DESIGN FOR COMFORT

the British cause in the international aviation lists justifies the observations.

As an aircraft the Tudor II is a first-class effort. The structure is just about as simple as it is possible to make it, and production will probably be easier than that of any previous Avro machine. With so great a keel surface area forward of the wings, something rather mastodonic in the way of fin and rudder area has to be provided to cope with directional stability and control, especially for the asymmetric case, which is causing so much hair-tearing despondency among designers generally. Briefly, this is an internationally agreed requirement which stipulates that, at take-off, the aircraft should be capable of full directional control when an outboard engine fails under the most adversely critical conditions. Obviously, when some 2,000-odd h.p., belting away well out along the wing, suddenly cuts out, the out-of-balance moment resulting is pretty powerful, and it is a stiff qualification to be able, by rudder alone, to hold the machine from swinging wildly whilst coping with the throttles, feathering the dead airscrew, retrimming and doing the other too numerous things necessary in such unhappy circumstances. Large fin and rudder areas give a high degree of directional stability, but consonantly increase the difficulty of attaining full rudder control by manual means alone. In fact, with really large rudder areas, manual means are insufficient, and some form of servo assistance must be provided; spring servo tabs—good as some of them are—must be regarded as something of an interim measure, and there is no doubt whatever that power servo systems, electric or hydraulic, will eventually become accepted practice for large and high-speed aircraft.



This illustrates the type of interior with which the author is at variance. The serried ranks of seats, small windows and lengthy curved roof all contribute to the repellent "packed-in-a-tube" feeling.

The fuselage of the Tudor II is pressurized for a differential of 5½lb./sq. in., and the basic layout of the system is very similar to that given a detailed description in the January 31st, 1946, issue of *Flight*. The smaller Tudor has an almost identical system, the chief difference being that, in the Tudor II, the main air supply to the cabin is carried in a central trunk in the roof enclosing two ducts. Each of these has branch pipes feeding to the cavities formed by inner and outer skins and the fuselage frames. One duct is supplied with fresh air and the other with clean recirculated air, alternate cavities being supplied by each. Grilles at floor and upper-berth level admit the air to the cabin, this having an out-flow to toilets, galley, etc., whence it is ducted overboard; the major part of the cabin atmosphere—about two-thirds—is, however, recirculated.

When dealing previously in *Flight* with pressurization and cabin atmosphere conditioning, the point has always been stressed that humidifying equipment *must* be incorporated. Flying at altitudes of the order of 25,000ft., even in temperate climes, the moisture content of the atmosphere is very low, and air entrained and heated for supply to the cabin will have a further reduction of relative humidity, bringing it down to a maximum of somewhere about 5 per cent. The acceptable humidity range for comfort is 30 to 70 per cent., with 50 per cent. as ideal, so it is readily appreciable that passengers flying at 20,000 to 25,000ft. without humidifying equipment will find themselves suffering from sore throats and experiencing a discomforting dryness of skin. Drinks carried on board will give partial alleviation, but liquids are heavy and, as such, are uneconomic. Humidifying equipment is being developed by at least two concerns in this country, and it is to be hoped that a suitable installation will be available when the aircraft requiring it are put into service.

To sum up, one can say without reservation that with the Tudor II A. V. Roe and Co. have given us an aircraft which undoubtedly will be a worthy upholder, in the civil field, of the magnificent operational precedent established by the Lancaster in the military sphere. But the present position and future outlook of British civil aviation is not so hopeful that there can be the slightest justification for operators not giving to interior arrangement something of the design quality put into the aircraft as aircraft.

TUDOR II DATA

GENERAL PARTICULARS

Four Rolls-Royce Merlin 102A engines of 1,770 b.h.p. driving de Havilland Hydromatic four-blade airscrews of 12ft 6in diameter.

Wing area			1,421 sq. ft.
Aspect ratio			10.13
Dihedral (outer panels)			4 deg.
Incidence			4 deg.
Aerofoil			N.A.C.A. 23,000 modified.
T/C Ratio	root		18 per cent.
	tip		9 per cent.
Root chord			16ft.
Tailplane span			43ft.
Tail surfaces aerofoil			R.A.F. 27
Max. all-up weight			77,000 lb.
Max. landing weight			70,000 lb.
Wing loading			54.2 lb/ sq. ft.
Span loadings	At 77,000 lb	$\frac{W}{b^2}$ =	5.35 lb/sq. ft.
	" "	$\frac{W}{b}$ =	642 lb/ft.
	At 67,000 lb	$\frac{W}{b^2}$ =	4.65 lb/sq. ft.
	" "	$\frac{W}{b}$ =	558 lb/ft.
Max. power	1,770 b.h.p. engine	=	7,080 b.h.p.
Max. W.M. cruising power	1,130 b.h.p./engine	=	4,520 b.h.p.
Power loading at 77,000 lb			10.87 lb/b.h.p.
at 67,000 lb			9.46 lb/b.h.p.
Max. speed			325 m.p.h. at 20,500ft.
Max. W.M. cruising speed			287 m.p.h. at 22,500ft.
Take-off at 77,000 lb (ground run)			860 yd.
Distance to clear 50ft from rest			1,480 yd.
Landing run at 70,000 lb			850 yd.
Normal tankage			2,420 Imp. gal.
Max. installed tankage			3,300 Imp. gal.
Max. normal range			2,950 miles.
Max. possible range			4,100 miles.
Payload for max. normal range			7,150 lb.
Max. useful length of fuselage			86ft 10in.
Max. fuselage diameter			11ft 0in.
Max. internal beam			10ft 4in.
Useful fuselage floor area			574 sq. ft.
Useful volume			4,020 cu. ft.

65-Passenger Version—
1,850 miles range at 230 m.p.h. at 20,000ft.

40-Seat/20 Berth Version—
2,450 miles range at 230 m.p.h. at 20,000ft.

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PERFORMANCE: With two D.H. Gipsy Major Series 1 four-cylinder in-line inverted air-cooled engines of 130 h.p. per engine at sea level.

Maximum speed, sea level	162 *m.p.h.*
Maximum cruising speed, sea level	148 *m.p.h.*
Cruising range	463 *miles.*
Rate of climb ...	1,100 *ft. per min.*
Absolute ceiling	19,200 *ft.*
Service ceiling	17,730 *ft.*

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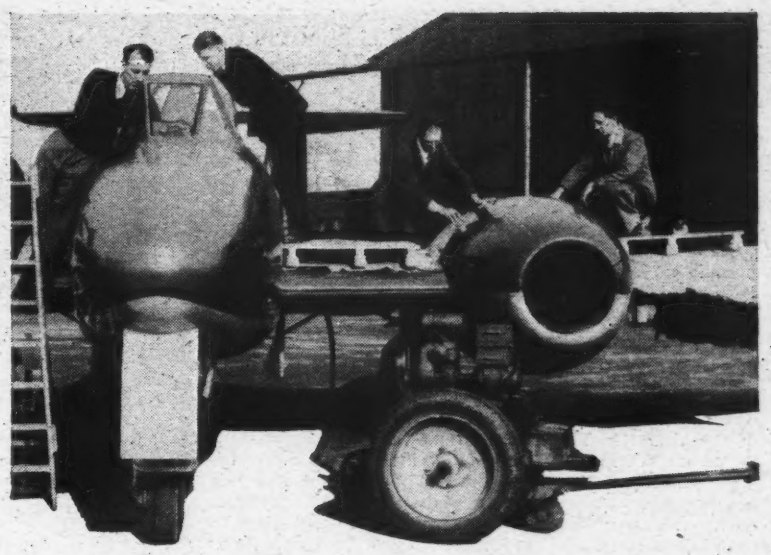
Keeping Them Running

The Maintenance and Servicing of Gas Turbines for Aircraft Jet Propulsion

By Squadron Leader
R. M. CRACKNELL,
M.B.E., A.M.I.Mech.E.



THE maintenance of a gas turbine is very considerably simplified compared with the piston engine by virtue of the small number of moving parts. Advantage of the absence of such components as magnetos, plugs, ignition harness and carburettors, together with the mechanical side including pistons, multi bearings, valve gear and airscrews will be obvious.

In general, operating experience has proved this type of engine to be exceptionally trouble-free and reliable. During the early days of development there were customary teething troubles, chiefly confined to the fuel system and bearings. There was also a period when the cracking of impellor blades was not an uncommon occurrence. The combustion assembly has remained fairly reliable throughout the development life of the engines which were cleared for flight, the chief trouble being confined to flame-tube distortion and, in the earlier days, carbon formation and coking troubles, customarily due to faulty burners. Turbine failures have, fortunately, always been very remote. Usually this only happened when the engine was undergoing trials in the test chamber, when results were not unnaturally catastrophic.

LITTLE is known by flying personnel of the maintenance and servicing operations with gas turbines. In this article, for the first time, the experiences of practical ground engineers with aircraft gas turbines are revealed and valuable advice embodied. It forms part of a lecture to B.O.A.C. maintenance engineers by the author.

The operating costs of a power plant take into account the primary costs attributed to labour and materials, plus the overhead charges pertaining to servicing and maintenance. When comparing these costs with those of the reciprocating power plant, it will be seen that the jet has many inherent advantages including appreciably reduced labour expenditure, due to the simplified maintenance, cheaper and safer fuels and, relevantly, insurance reductions concerning fire risks and compulsory precautions, quicker turn-arounds, representing increased flying hours available per unit period, and in addition high reliability.

Trouble-free Rotor Assembly

The rotor, including the compressor, turbine and wheelcase, is now virtually trouble-free. The only remaining source of trouble is the fuel system, where periodically such components as the fuel pump or A.C.U. may need replacement, due to failure or internal adjustment.

Jet engines are installed in airframes as complete units with the jet pipe detached from the exhaust cone, depending on the particular design. The engine mountings normally consist of two or three main trunnion bearers, and one front or rear mounting pick-up point with a tail support for the jet pipe, of hinge design to allow for longitudinal expansion under running conditions. The following is a typical list of components to be connected.

(I) *Engine.*—(a) Fuel pipe to the engine pump and A.C.U. or "all-speed" governor return; (b) fuel drain pipes from the fuel system; (c) electric starter motor and booster coil electrical connections; (d) auxiliary drive to the accessory gear box (if fitted); (e) accessories and connections (where auxiliary gear boxes are not used); (f) fire extinguisher ring.

(II) *Controls.*—(a) Throttle and H.P. cock.

(III) *Instrumentation.*—(a) Jet pipe temperature thermocouples; (b) R.P.M. tachometer connections; (c) burner pressure fuel gauge connection; (d) oil pressure and temperature connections.

It is normal to take a series of readings at cruising, climbing and maximum take-off r.p.m. conditions during the proof run for flight clearance after installation. The only adjustment normally found necessary during this proof run is the governor setting to give the desired maximum r.p.m. and the idling r.p.m. stop on the throttle by-pass.

Engine Changes.—It is invariably quicker to change an engine installed in an aircraft than to rectify any major defects. A typical period of installation life laid down for a gas turbine of centrifugal design at the present time is up to 180 hours. This, however, does not represent the life of the engine by any means, but rather a safe conservation pending further experience. The useful life of a gas turbine may very well ultimately reach 1,000 flying hours without difficulty, particularly when not subjected to sudden inertia changes, as in the case of fighter aircraft.

Time-study investigation reveals a substantial saving in man hours for engine changes compared with the piston engine. There is about 70 per cent saving in labour costs.

Daily servicing of a gas turbine compared with the orthodox reciprocating I.C. engine power plant is also in every way far simpler and less involved. The two chief sources of trouble experienced on the reciprocating engine are considered to be attributed to ignition and carburation. Both these factors are non-existent in the gas turbine, while in the case of the simple jet engine there is the added elimination of the airscrew and its controls.

From the labour aspect a pronounced saving of man-hours is effected. To quote experience, the average time to complete a D.I. on a modern reciprocating power plant takes an experienced crew approximately 3½ man-hours (including all trades), whereas a D.I. on a Derwent, installed in a Meteor, for instance, can be completed in about 15-20 per cent. of this time, representing approximately 83 per cent. labour saving. (The figures given are only an average and do not take into account any troubles which may be experienced.)

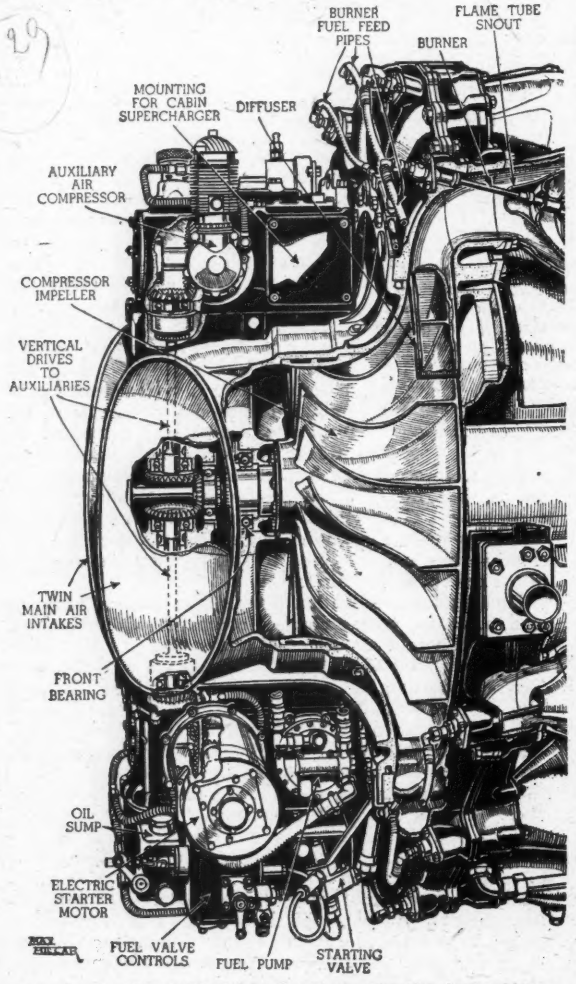
A.69

KEEPING THEM RUNNING

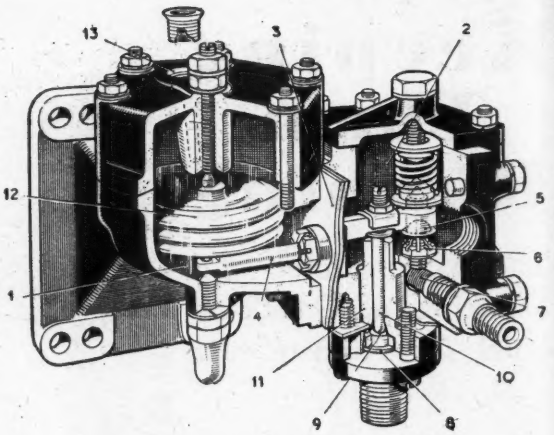
A normal daily inspection on a jet turbine may be summarised to consist of an external examination for oil and fuel leaks, checking the correct level of the lubricating oil in the oil reservoir, viewing up the jet pipe (by torch or mirror reflection) for any signs of turbine blade damage or heat effect, and a "motoring" check for freeness of rotation (by operating the engine through the normal method of starting with the H.P. cock "off"). It is not normal to remove the main engine nacelle cowlings for D.I.s, and in certain instances ground run checks are not considered essential.

Inspected in Airframe

Minor inspections are so arranged as to synchronise with the airframe inspection periods. This arrangement has a direct reflection on the operating costs and flight planning of the aircraft. The average time taken to carry out a minor inspection on a centrifugal installation represents approximately 10-12 man-hours per power plant and does not necessitate removing the engine from the airframe. Such work occupies but a fraction of the time taken to complete the airframe inspection. Again by comparison, it shows a marked contrast to the reciprocating engine, which may take up to 60 man-hours.



Front end of the de Havilland Goblin showing the single-sided impellor, accessories and drives. The items most likely to require attention are mentioned in the text.



Barometric Pressure Control Unit.

1, Capsule chamber; 2, Valve chamber; 3, Pivot plate; 4, Rocker; 5, Half-ball; 6, Orifice; 7, Filter; 8, Diaphragm; 9, Piston; 10, Operating rod; 11, Eccentric adjusting sleeve; 12, Barometric capsule; 13, Vent to atmosphere.

A typical minor inspection for the centrifugal compressor gas turbine will include:—

(a) Impellor-blade inspection for signs of cracks, etc. (visual).
(b) Removal and partial inspection of the combustion assembly for distortion or flame tube buckling, also for any signs of carbon formation, due to fuel spray impingement or flame chilling.
(c) Air casing inspection (for distortion and fracture) (visual).
(d) Turbine nozzle guide vane inspection (visual). Jet pipe removed for the examination of cracks, blade distortion or local overheating.
(e) Turbine blade inspection (with jet pipe removed) for signs of fatigue cracks, buckling or loose blades.
(f) Turbine blade tip clearance check. It is normal to check the tip clearances at 45 deg intervals around the periphery of the shroud ring to determine the minimum blade clearance. This action gives a mechanical check on the growth of the turbine disc and blades or distortion of the shroud ring. (Turbine blades usually carry a safety lip at the tip which is designed to give way in the event of a turbine "rub." Such troubles, however, are now very rare.) Conversely, excessive tip clearances are detrimental to the turbine efficiency since the gas leak rate is increased.
(g) Exhaust cone inspection for buckling and cracks.
(h) Oil scavenge filter inspection.
(i) L.P. and H.P. fuel filter inspection.
(j) General visual inspection of the engine.

Major overhauls necessitate the removal of the engine from the airframe and the carrying out of a complete strip for both visual and dimensional checking. In the past it has sometimes been found necessary to renew the flame tubes and refit new burners. Little deterioration is experienced with the main rotor assembly.

Ground Handling

Practically all ground equipment required for the normal servicing and maintenance of jet aircraft is standard. Typical items peculiar to jet engines (apart from the relevant tool kits and engine slings) may be considered to consist of high-capacity, close-mesh fuel filters from the bowser supply to the aircraft fuel tanks, air intake and propelling nozzle covers to protect the compressor and turbine when not operating, and portable pyrometry test gear for thermo-couple testing.

Certain essential precautions are enforced in the interests of safety during all ground running of jet engines installed in aircraft, particularly during proof runs when the nacelle cowlings are not fitted. Apart from the discomfort of noise, it is unwise to approach the vicinity of the compressor intake when the turbine is operating under power, due to the high suction effect in the proximity of the air intake. Possible consequences may be serious to the individual and disastrous to the engine.

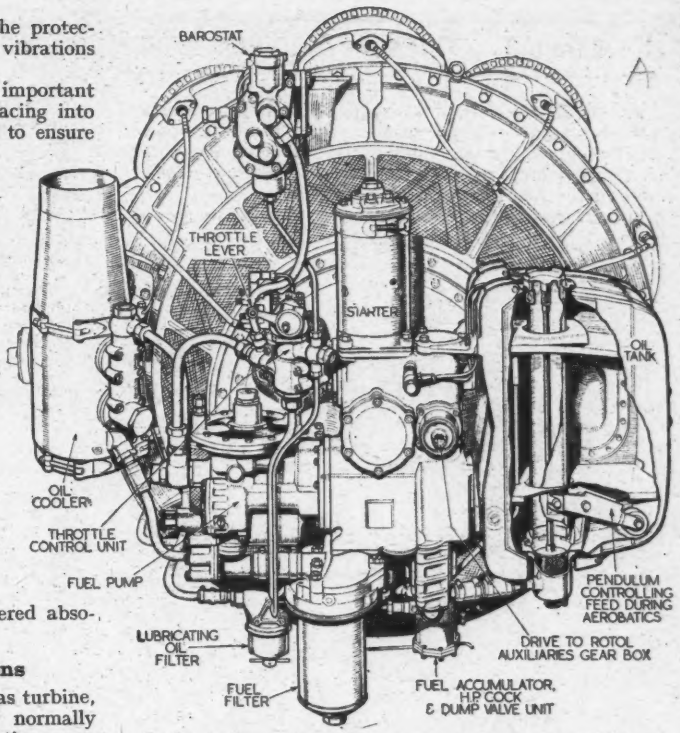
In this respect, loose items of clothing or articles are a great source of potential trouble. One-piece boiler suits are considered the ideal clothing for ground personnel engaged on this work. It is also highly recommended that all ground personnel associated with continual ground

running of jet engines wear ear defenders for the protection of the ear drums from the high-frequency vibrations which are emitted during power running.

When carrying out ground runs it is most important that the compressor intake or intake duct is facing into wind. This is essential for three reasons: first to ensure that the exhaust gases do not recirculate to the air intake, which would have the detrimental effect of raising the jet pipe temperature (particularly emphasised at idling r.p.m.), the latter being dependent on the square of the intake temperature change; secondly, cooling of the engine is assisted; and thirdly, on shutting-down, the ram effect from the ambient air has the helpful result of purging the engine.

Observation should also be made to ensure that the exhaust gas stream has a clear path after emission. No area or objects subject to heat effect or deterioration should be in the path of the jet stream.

In preparing a jet engine for storage, the normal protective action is taken by inhibition spraying of the engine. It is unnecessary to carry out any special precautions other than the normal blanking, etc. Corrosive reaction is not present, since leaded fuels are not used. If practicable, it is advisable periodically to rotate the rotor to preserve the oil film on the moving components, though this is not considered absolutely essential.



Fuel injection and control components grouped on the front of the Rolls-Royce Derwent compressor.

Operational Faults and Rectifications

Due to the inherent simplicity of the simple gas turbine, it has been stated that little trouble is normally experienced concerning the servicing and operation compared with a modern reciprocating power plant. What troubles are experienced can be traced and analysed without much difficulty. The troubles encountered may be separated into four main categories:—

(a) Failure to start.
(b) Rough running.
(c) Erratic operation.
(d) Incorrect jet pipe temperature indication.

Failure to Start.—When a gas turbine fails to start there is little object in continuing the attempt. Actually it may prove disastrous by possibly producing an excessively hot start, or alternatively aggravating existing mechanical failure. The cause will invariably be traced to one of the following troubles:—

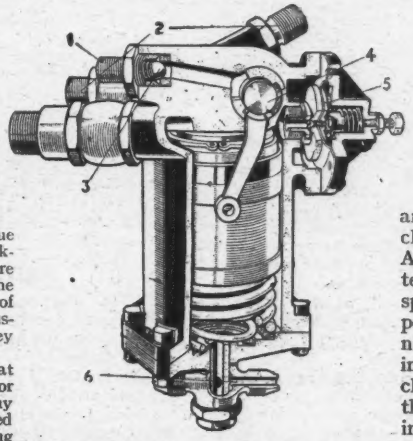
(1) *No Ignition.*—Elimination of the ignitor plugs, booster coils, electrical starter circuit and accumulator state will define this cause.

(2) *Insufficient Fuel Pressure to the Burners.*—Low fuel pressures may be due to one or more of the following causes: (a) A faulty fuel pump; (b) excessive fuel leaks; (c) an excess A.C.U. relief (if fitted); (d) failure for the pump valve or fuel accumulator to operate; (e) insufficient r.p.m. to produce requisite fuel pressure and mass flow; (f) slow-running adjustment of the throttle, by-pass set at too low a value; (g) air in the fuel system.

Items (b) (d) and (e) will be indicated visibly, while (a), (c), (f) and (g) can be examined independently.

(3) *Insufficient r.p.m.*—This usually indicates a low voltage of the accumulator. It may also be caused by the starter motor not receiving full electrical power due to the energising solenoid resistance not breaking contact. Alternatively, the partial seizure of the rotor or an auxiliary drive may be the cause. (The r.p.m. indicator should first of all be checked for correct reading before suspecting any of the above faults unless they are obviously apparent.)

(4) *Mechanical Failure.*—It is seldom that the rotor (combining the compressor rotor or impellor and turbine) gives rise to any mechanical failure. It will be appreciated that this is more apt to happen when running under "power" conditions. This failure, however, is a very rare occurrence. Secondary mechanical failures include the fracture of auxiliary drives and gear trains affecting components such as the H.P. fuel pump, starter motor, oil pressure and scavenge pumps and any auxiliary components.



Accumulator, trip valve and high-pressure cock.

1, Connection to pump inlet; 2, Connections to manifold; 3, Relief valve; 4, High-pressure cock; 5, Trip valve; 6, Spill to atmosphere

Rough Running.—As a gas turbine produces its power by rotation of the major components there is very little vibration compared with the reciprocating I.C. engine where high opposed inertia forces are present. There are in certain engines, however, the characteristic critical periods operating through certain ranges of r.p.m. which it is advisable to avoid in view of the resonance set up, which eventually may lead to an impellor or turbine blade failure in the form of fatigue. What little vibration does exist in a gas turbine is of very high frequency, around the order of r.p.m. cycles per second. If there are any signs of unusual roughness, this may possibly be due to the impellor and turbine rotor combination being out of dynamic balance, probably due to a partial failure of an impellor or turbine blade. Both these instances are of a serious character and necessitate a complete strip of the engine. Defective rotor bearings or auxiliary drive failures may also promote rough running.

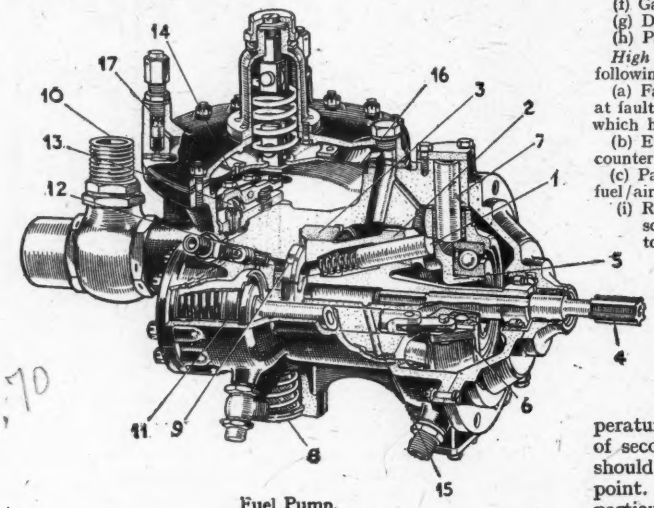
Erratic Operation.—Erratic running will be attributed in practically every case to the fuel system, and in such cases it is customary to change either the throttle valve or the A.C.U. (if fitted). When the fuel system is incorporated with an "all-speed" governor, this unit will be suspect. In certain cases, erratic running may be due to one or more burners in the combustion system being choked, thus causing bad distribution: this fault is usually indicated by viewing up the propelling nozzle from a distance while the engine is running and observing any local hot-spot areas which may be apparent around the annulus of the turbine blades.

KEEPING THEM RUNNING

Failure of the flame tubes of the combustion system will also produce erratic running plus a loss of power, usually indicated by a high burner pressure and a high jet temperature. A loss of power may be due to one or more of the following causes:—

(a) Insufficient burner pressure (indicated by a low jet pipe temperature).

(b) A faulty combustion system due to excessive carboning or failure of one or more flame tubes due to heat deterioration.



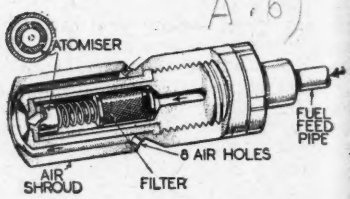
Fuel Pump.

1, Plunger; 2, Rotor; 3, Carbon bush; 4, Quill shaft; 5, Cam plate; 6, Control ring; 7, Trunnion pin; 8, Inlet strainer; 9, Ported valve insert; 10, Delivery connection; 11, Pressure control piston; 12, Restricting orifice; 13, Platevalve; 14, Rocker; 15, Radial holes in rotor; 16, Diaphragm; 17, Bleed valve.

(c) Choked burners (indicated by high burner pressure and a drop in maximum r.p.m.).

(d) Excessive clearance of the impellor to the impellor casing, allowing a large pressure loss.

(e) An aerodynamic breakdown of the turbine nozzle guide vanes or turbine blades.



Fixed-orifice burner with sectioned detail of swirl chamber.

(f) Gas leaks at the turbine shroud exhaust cone joints or jet pipe

(g) Distortion of the propelling nozzle.

(h) Partially seized bearings.

High Jet Pipe Temperature.—May be due to one or more of the following causes:

(a) Faulty Pyrometry.—In the event of the instrumentation being at fault this can be checked by introducing a master thermo-couple, which has a known calibration, into the jet pipe.

(b) Engine Overspeeding.—This will be indicated on the r.p.m. counter and also by a high burner pressure.

(c) Partially Blocked Compressor Intake.—This causes a high fuel/air ratio.

(i) Running the engine with the aircraft heading out of wind, so causing the hot exhaust gases from the propelling nozzle to recirculate and re-enter the air intake.

(ii) Turbine Cooling Air at fault, causing excessive blade temperatures.

(d) Faulty combustion, such as buckled or partially collapsed flame tubes or a heavy gas leak, causing a high F/A ratio.

(e) A falling-off in compressor performance.

High jet-pipe temperatures must be investigated without delay. On this depends the life and safety of the engine. Short bursts of high jet-pipe temperature may be permitted on certain engines for a matter of seconds, particularly when starting, but this condition should never be allowed to continue to any saturation point. When an engine has been subjected to overheating, particular attention should be given to the turbine blading for any indication of temperature fretting or distortion. These faults are only a general appreciation. Each particular type will necessarily have its own peculiarities.

TESTING JET ENGINES

COMMENTING on Dr. Roxbee Cox's Wright Brothers Lecture in Washington, Mr. Carlton Kemper, executive engineer of the Aircraft Engine Research laboratory of the American N.A.C.A., disclosed that at Cleveland the N.A.C.A. had a 20ft diameter altitude wind tunnel for power-plant testing in which speeds up to 500 m.p.h. can be attained, at equivalent altitudes ranging from ground level to 50,000ft and at air temperatures as low as −47 deg F. It is interesting to learn that one of the important results discovered in this tunnel is that the performance characteristics of combustion chambers at flight altitudes cannot be successfully predicted from performance tests at sea level conditions. One of the few troubles with turbine engines—behaviour at altitude—has not yet been entirely solved, and such a tunnel must be invaluable in shortening the process.

UTILIZING TEST-BED ENERGY

SEVERAL years ago *Flight* and its associated journal, *Aircraft Production*, advocated the utilization of the power wasted in testing aircraft engines during production. The question has since been seriously investigated by D. Napier and Son, Ltd., and during the war they installed at their Acton factory a series of regenerative-dynamometer test beds by means of which the millions of units of power generated during development testing of Sabre engines was fed to the public mains. In the current issue (April) of *Aircraft Production*, the company's test-plant installation engineer describes the plant in detail and assesses its value in the light of more than two years' satisfactory operation.

Other features in *Aircraft Production* for April include articles on the Northrop method of manufacturing spar booms for the P-61, on electronic control in resistance welding; and on motion-study—the science by which operatives' hand-movements and bench equipment are analysed with a view to preventing wastage of effort and time. There is also a final instalment of the series of articles on the production of the Rolls-Royce Griffon 65.

GROUP OFFICERS' ASSOCIATION

MARSHAL of the R.A.F. Lord Tedder, will be the guest of honour at the 83 Group reunion dinner which will be held at the Connaught Rooms, London, tomorrow evening. Among other guests will be Air Marshals Sir Arthur Coningham and Sir James Robb, Air Vice-Marshals Sir Basil Embry, Sir T. W. Elmhirst and Victor E. Groom and Air Comdres. H. P. Fraser and Howard-Williams. As members, Air Vice-Marshals Sir Harry Broadhurst and Sir William Dickson will be there and the chair will be taken by Air Vice-Marshal Trail, who is A.O.C. 83 Group and president of the association. About 300 are expected to be present.

No. 83 Group, as part of 2nd T.A.F., fought right through to the end from the Normandy Beaches to Schleswig. The table below shows the units comprising the Group and the aircraft with which they were equipped.

Wing.	Aircraft.	Squadrons.
121	Typhoon (Rockets)	175, 184, 245.
122	Tempest V.	3, 56, 80, 486 (R.N.Z.A.F.)
124	Typhoon (Rockets)	137, 181, 182, 247.
125	Spitfire XIV.	41, 130, 350 (Belgium).
126	Spitfire IX and XVI.	401, 402, 411, 412 (All R.C.A.F.)
127	Spitfire IX and XVI.	403, 416, 421, 443 (All R.C.A.F.)
143	Typhoon (Bomber)	438, 439, 440 (All R.C.A.F.)
39R	Spitfire XII.	400, 414, 430 (All R.C.A.F.)

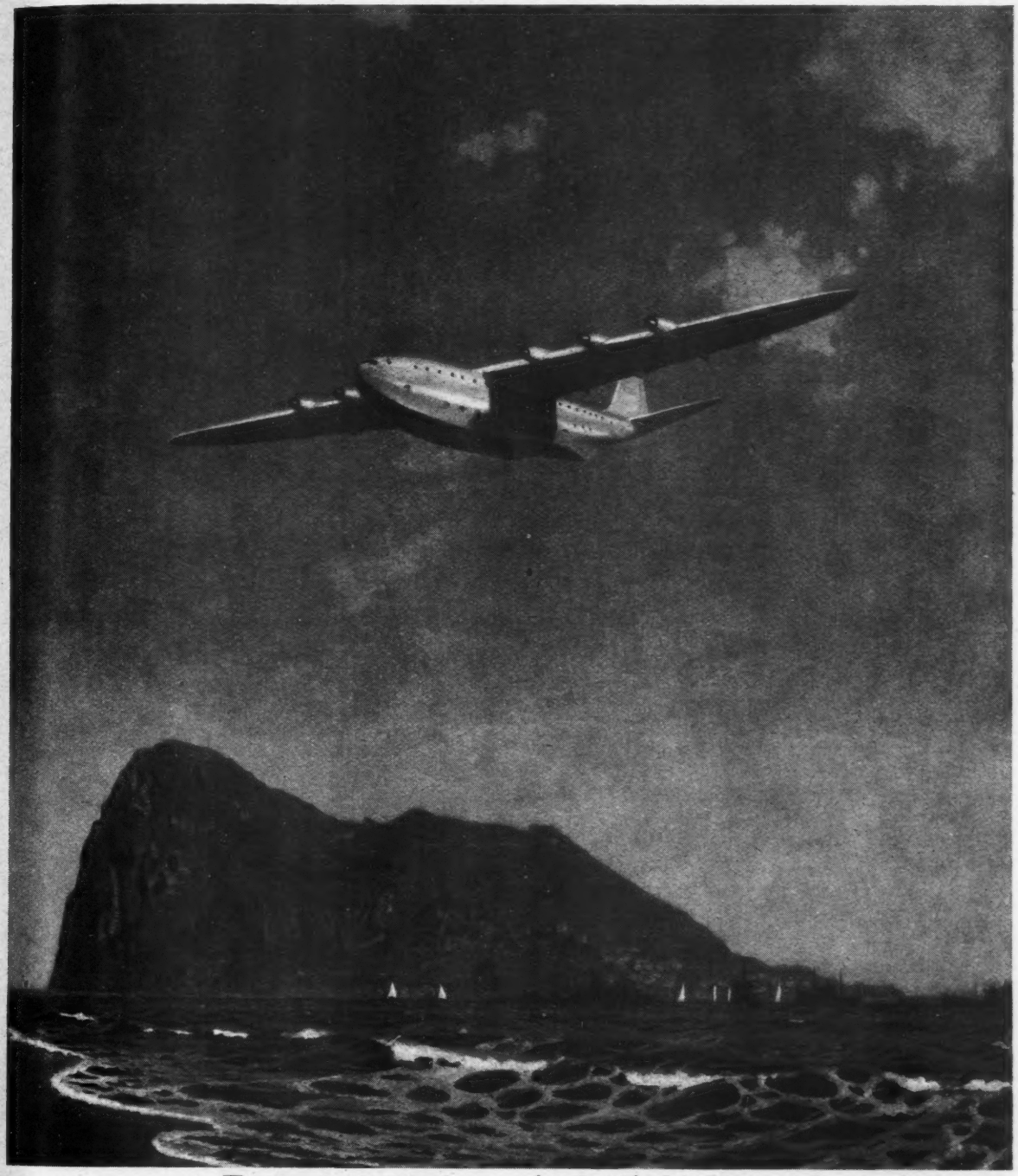
REDUNDANT AIRFIELDS

UNTIL the size of the post-war R.A.F. is determined, no forecast can be made as to the number of airfields in the United Kingdom which will eventually become redundant.

This statement was made by the Under-Secretary of State for Air in the House of Commons recently. A large number of these airfields house a great deal of service equipment and there is a continuous investigation into how much of this equipment can be considered surplus.

It is not known how much of the surplus equipment will be made available to the public, but this is the responsibility of the Ministry of Supply and Aircraft Production to whom all surplus stores and equipment are usually reported.

SUPREME FOR OCEAN TRAVEL — THE BRITISH FLYING BOAT



The Rock of Gibraltar—and a British flying boat of the near future.

The large long-range flying boat will combine in the fullest measure, the speed of air travel with the safety of surface travel. Operating mainly over water, it can fly almost anywhere in the world and yet keep within easy reach of a safe haven in case of trouble.

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Flashback

" Remember the day we nearly pranged the old kite when flaps failed and we touched down at 120? We certainly stood on our brakes that day! Good old Leo FERODO!"

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CIVIL AVIATION

DUBLIN CONFERENCE CONTINUES

LACK of liaison between aircraft manufacturers and airfield authorities has been setting a problem for the Aerodromes Committee of the North Atlantic Route Service Conference, which has been meeting in Dublin for the past three weeks. The Committee members expressed the opinion that they should be in a position to determine maximum airfield measurements for the next ten years, but, lacking the necessary details of concrete proposals by aircraft manufacturers, they are unable to fulfil this task. It is probable, however, that the report of the conference to the Interim Council of the P.I.C.A.O. at Montreal will contain recommendations for the establishment of a liaison between airfield authorities and the aircraft industry.

A representative of one of the American operating companies has expressed the view in Dublin that landplane size will not go beyond 75-100-passenger-capacity. He based this—apart from operational difficulties—on the importance of frequency, two flights per day by 75-passenger aircraft being better than two flights per week by 500-passenger machines.

The Meteorological Committee has been seeking to establish a new code and symbols for weather information. It has been agreed that the pre-war codes are out-moded and that the military codes are not particularly useful for civilian use; a compromise code is being worked out and will be included in the Committee's report, which goes before the general assembly of the conference next week.

A tentative agreement has been reached whereby stationary vessels used for meteorological purposes may also be incorporated in the search and rescue service, while the possibility of their further utilization as additional navigational aids also has been considered.

There was considerable disappointment among the delegates who had expected to visit Prestwick at the invitation of the United Kingdom delegation. This had to be called off owing to "other commitments," but inspection trips to Shannon Airport were made to schedule. The cancellation of the Prestwick trip is to be regretted in view of the intense interest which the question of the location of the route control station has aroused. This matter has not yet been settled, and in some quarters there appears to be a desire to postpone a decision until a later date, or to refer it to P.I.C.A.O.

Although the present tendency is all for the use of landplanes, the opinion has been expressed at the conference that this may be merely a transitory phase, and full consideration has been given to the need for the provision of adequate facilities for flying-boats. Detailed reports of the work of sub-committees are now being drafted, and it is anticipated that the work of the conference will be concluded this week.

B.S.A.A. REGULAR SERVICE

A BI-WEEKLY service to Buenos Aires by British South American Airways Lancastrian has now begun, and the first of the regular aircraft, '*Star Trail*, arrived there last week. These flights will terminate at Montevideo, Uruguay, the southbound aircraft flying direct from Rio de Janeiro to Buenos Aires and then on to Uruguay.

LANCASTRIAN OVERDUE

AS we are about to go to press, it is reported that a Lancastrian, G—AGLX, on its way from Britain to Australia, is overdue. The machine left Ceylon for Perth, Western Australia, and a radio message was received from it when it was some 1,000 miles out from Ceylon. This would place the machine near the Keeling Cocos islands, where a stop was to have been made. Among the passengers on board the Lancastrian was Mr. J. Dobson, son of Sir Roy Dobson.

DOLLAR DEFICIENCY

ACCORDING to a correspondent, Scottish Airlines section of Scottish Aviation have been privately provided with the dollars necessary to continue the hire of the Dakota used for their Prestwick-Belfast service. This aircraft had been hired from the U.S. Liquidation Commission, but recently the Foreign Exchange Control said that the cash required could not be spared, and the service was suspended on March 5th. Both the Treasury and the Ministry of Civil Aviation were adamant in their refusal, but an American friend of Group Capt. McIntyre's came to the rescue with the necessary sum for a twelve months' lease. Incidentally, a Scottish Aviation Liberator recently flew on to New York preparatory to the possible establishment of an Atlantic charter service. We hear that this aircraft was refused permission to use Gandar on the trip, which may or may not be true and for which the reason may be less obvious than that of official disapproval generally.

REFUELLING

THERE appears to be no official method at present of informing individual pilots of the day-to-day improvement in the airfield fuel supply arrangements. Consequently, on many occasions business flying journeys may be cancelled because the pilot concerned has no information that his coupons are valid at a particular airfield, and is unwilling to take the risk of being stranded.

At the moment of going to press, the airfields where "coupon" fuel can be obtained are, with the octane values available, as follows: Croydon, Hurn, Lympne, Whitchurch, Speke, Prestwick (all grades at each), Cambridge, Derby, Portsmouth, Fairoaks (73 only at each), Perth, Luton, Walsall, Ringway (73 and 87 at each) and Tollerton (87). We hear that fuel can also be obtained at Eastleigh and Horsey Toll (Peterborough). As and when we learn of additions, the list will be amended or repeated.

SURPLUS DISTRIBUTION

ACTING as official agents for the U.S. Government War Assets Administration and assisting in the distribution of new and used aircraft surplus parts, the Frank Ambrose Aviation Company of Flushing, L.I., New York, is making a special point of the sale of transport aircraft and accessories, engines and ground equipment to airline operators. The Ambrose organization is also prepared to offer technical assistance to operators in the matter of personnel selection, maintenance and operational advice.

Among recent Ambrose sales have been that of three PBY-5A Catalinas to Air France for service in the Caribbean, three more to Pan American Airways, and one to Venezuela. Quantities of 1830-92 Pratt and Whitney engines have also been supplied to operators.

Alec Ulmann, well known in Anglo-American aviation circles prior to the war, is now back in the flying business as vice-president of the concern.

PACIFIC PLANS

BEFORE the summer of the coming year a British series of air services should be in operation between New Zealand, Australia and Canada. This decision was one of the results of the South Pacific Air Conference held recently at Wellington, New Zealand, and attended by Lord Winster, the Minister of Civil Aviation. An agreement has also been concluded with Australia to provide for future pooled services between Australia and this country.

There will actually be two Pacific services, one operated by Trans-Canada Air Lines, and the other jointly by British, Australian and New Zealand operators. For a start there will be two services a week in each direction, with stops at Fiji, Canton Island, Honolulu and San Francisco. The terminals will be Sydney, Auckland and Vancouver. The S.P.A. Conference recommended the establishment of a South Pacific Air Transport Council with a permanent secretariat in Australia. This Council will provide the necessary machinery for consultation between the various interests, and will also advise the Governments concerned on matters connected with the development of Pacific services. It is, in point of fact, an extension of the Commonwealth Air Transport Council, and a parallel of the South African Air Transport Council which was formed last year.

The combined organization, including the interests of Australia, New Zealand and the United Kingdom, will, it is recommended, be vested in a new organization known as British Commonwealth Pacific Airlines. No decision has yet been taken about the aircraft types to be used by B.C.P.A., but Trans-Canada Air Lines will be using Canadian-built Merlin-engined DC-4s, and presumably Tudor IIs will eventually be available for the other organization. Australian National Airways will operate an interim service from Sydney with DC-4s or Skymasters. Two of the four on order have already arrived in Australia.

CIVIL AVIATION NEWS

FOR ASTRO-NAVIGATORS

THE Air Ministry is now releasing for sale a stock of Air Publication 1618—alias astronomical navigation tables. They can be purchased from the Air Publications and Forms Store, Air Ministry, 81, Fulham Road, London, S.W.3. Details of the particular volumes which are available are given in *Notice to Airmen No.* 27 of this year.

STRATOCRUISERS FOR SWEDEN

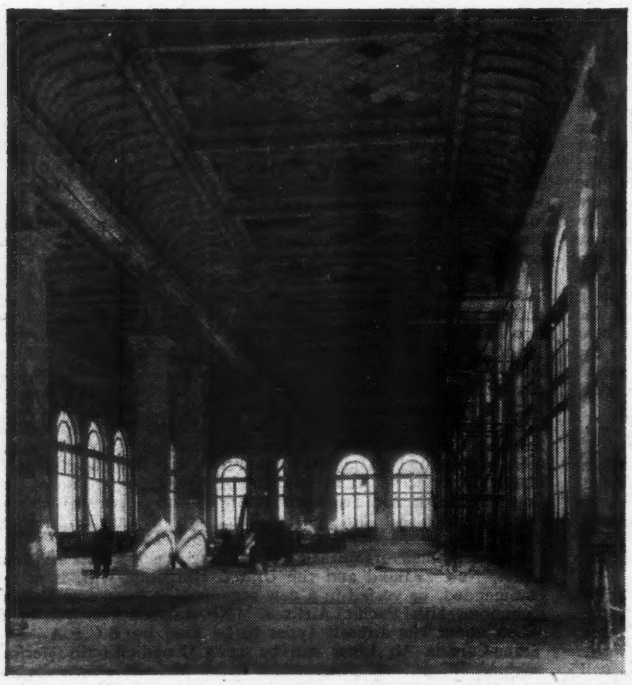
SWEDISH Intercontinental Air Lines have placed an order for four Boeing Stratocruisers for their Atlantic service, which is at present being provisionally operated with B-17 Flying Fortresses. To cover the intervening period, before the delivery of the new equipment, Douglas DC-4s are to be used. It is the first order, outside America, for the Stratocruiser, though Pan American World Airways are reported to have ordered twenty of them.

G.A.P.A.N. DINNER

THE Guild of Air Pilots and Air Navigators is to hold its 16th Annual General Meeting at the Royal Aeronautical Society, 4, Hamilton Place, London, W.1, on Thursday, April 4th, at 5 p.m. The annual meeting will be followed by a members' dinner on the same evening, at Gunters in Park Lane, at 7.30 p.m. Private guests cannot be invited, however, as accommodation is limited. Tickets, price 35s inclusive, can be obtained from the Secretary General of the Guild at Londonderry House, 19, Park Lane, London, W.1.

INTERNATIONAL METEOROLOGY

ALTHOUGH nothing of much practical interest was decided, the fact that the International Meteorological Office recently held its first post-war conference in London should be recorded. The meeting, to use the Air Ministry's official expression, was in the nature of an "extraordinary conference to clear up the aftermath of war." Some eighty delegates attended, and the chairman was Dr. Hesselberg, of Norway, who has been president of the I.M. Committee since 1935. His place will now be taken by Sir Nelson Johnson, director of the London Meteorological Office.



CONVERTED RAILWAY TERMINUS : The Gare des Invalides, Paris, is being converted into an air terminal building to serve the airfields at Orly and Le Bourget. A car park will be provided on the lower level formerly occupied by railway lines.

THE FILTON RUNWAY

SOME thirty-six houses will have to be demolished in order to extend the Filton runway sufficiently for the Brabazon I to be flown out. This information was given by Mr. Wilmot, the Minister of Supply and Aircraft Production, in the House of Commons in reply to a question on Monday, March 18th. The Minister added that the earliest possible notice will be given to those whose land and buildings will have to be acquired, and fair compensation will be paid to them. In addition, alternative accommodation will be provided beforehand for local residents who may be dispossessed of their homes.

It is gratifying to know that a firm decision has been made at last on the subject of the Filton runway extension, and also that Mr. Wilmot is sending Ministry representatives to Bristol, in order to explain to those residents personally what is proposed.

REDUCING WHEEL WEIGHT

SOME of the many problems in the design of wheels and tyres for large aircraft were described by Mr. J. Wright, the general manager of the Dunlop Rim and Wheel Works, when he read a paper to the Coventry branch of the Royal Aeronautical Society recently.

Although the payload of civil aircraft would be very usefully increased by reducing the size and weight of aircraft wheels and by increasing the tyre pressures, the possibilities could only be fully exploited if and when all airfields had runways which were sufficiently strong. In fact, with an aircraft having an all-up weight of 40,000 lb., a saving of about 500 lb. in structure weight could be made by increasing the standard tyre pressures from 35 to 90 lb. per sq. in.

Such pressures, however, involved very heavy surface loadings and meant that prepared runways—preferably of reinforced concrete—were essential. Similar attention, in the matter of surface strength, would naturally have to be paid to the construction of perimeter tracks and hard standings. In the old days of grass airfields inflation pressures were limited to 35 lb. per sq. in. simply because, if higher pressures and smaller tyres were used, the aircraft became bogged on any but the hardest grass surface.

One of the big problems in brake design had been that of finding means of absorbing and dissipating the heat developed in a mechanism which was necessarily very compact. The brakes of a modern four-engined aircraft, said Mr. Wright, had to dissipate several million foot pounds of kinetic energy in a matter of 20 to 30 seconds.

FROM AUSTRALIA

AIR MARSHAL RICHARD WILLIAMS, C.B., C.B.E., D.S.O., has been appointed Australian Director-General of Civil Aviation, and is expected to take up his duties in about six weeks' time after visiting this country and the U.S.

* * *

The Australian Government is shortly to introduce a Bill authorizing the purchase of all shares held by B.O.A.C. in Qantas Empire Airways. Qantas will thus be made an all Australian concern.

* * *

The first part of the plan to convert and modify Mascot airfield, Sydney, to modern standards has been approved by the Cabinet. The plans include one 3,000 yd. runway and three others of 1,700 to 2,000 yd. The first stage will cover a period of five years' development. After that there will be an extension of the long runway, and, in due course, runway duplication and the organization of a really up-to-date flying-boat base. The work will be completed in three stages.

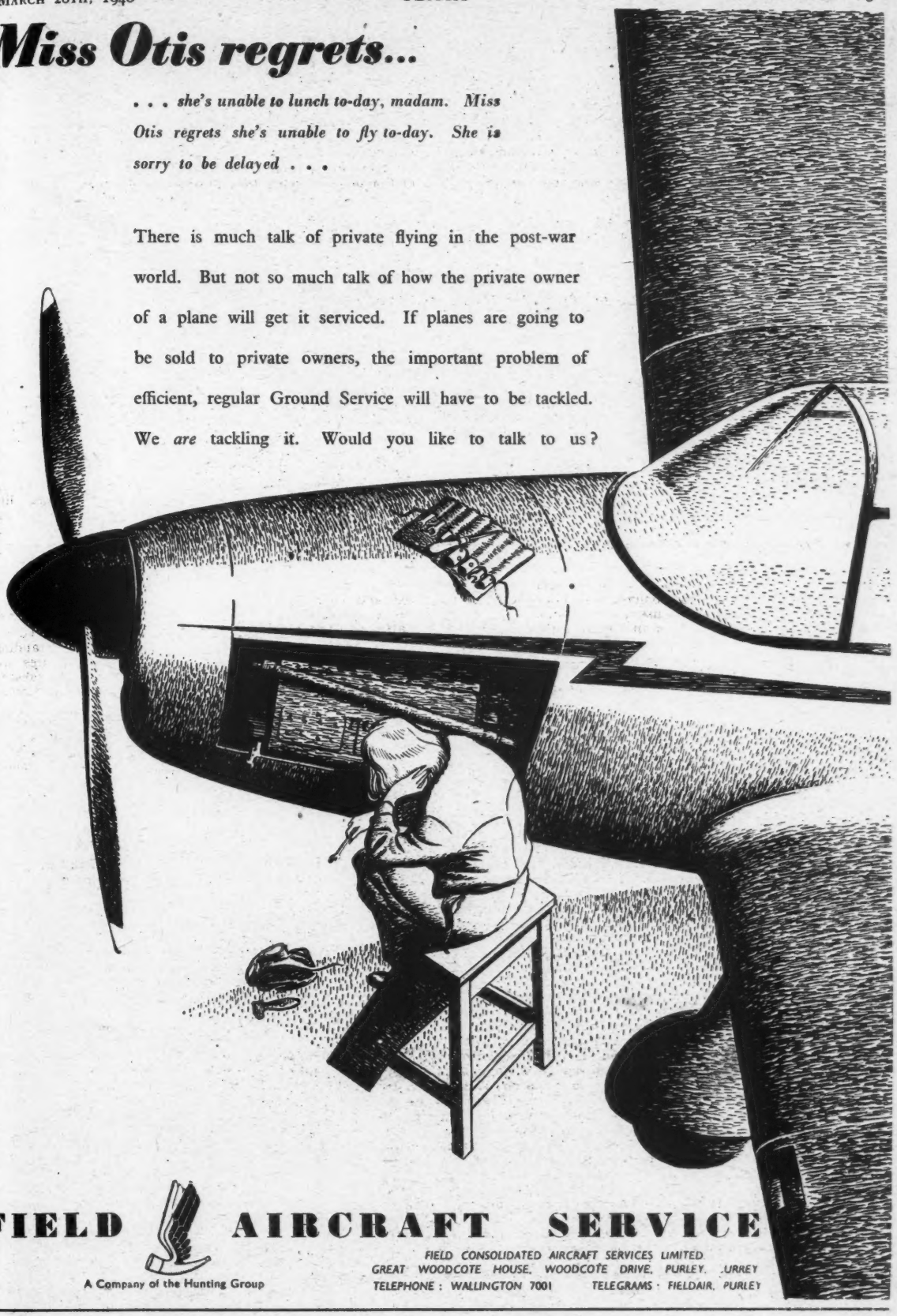
* * *

What is probably the world's first freight-only service has been started by the Roy Farrell Aviation Company, which will operate a regular service between Sydney and Shanghai, using Dakotas, five of which have been purchased. The route will be via Cloncurry, Darwin, Morotai, Manila and Hong Kong. Mr. Farrell himself has more than five hundred "Hump" trips to his credit while flying with the U.S. Army Air Corps, so he should know what it is all about.

Miss Otis regrets...

. . . she's unable to lunch to-day, madam. Miss Otis regrets she's unable to fly to-day. She is sorry to be delayed . . .

There is much talk of private flying in the post-war world. But not so much talk of how the private owner of a plane will get it serviced. If planes are going to be sold to private owners, the important problem of efficient, regular Ground Service will have to be tackled. We *are* tackling it. Would you like to talk to us?



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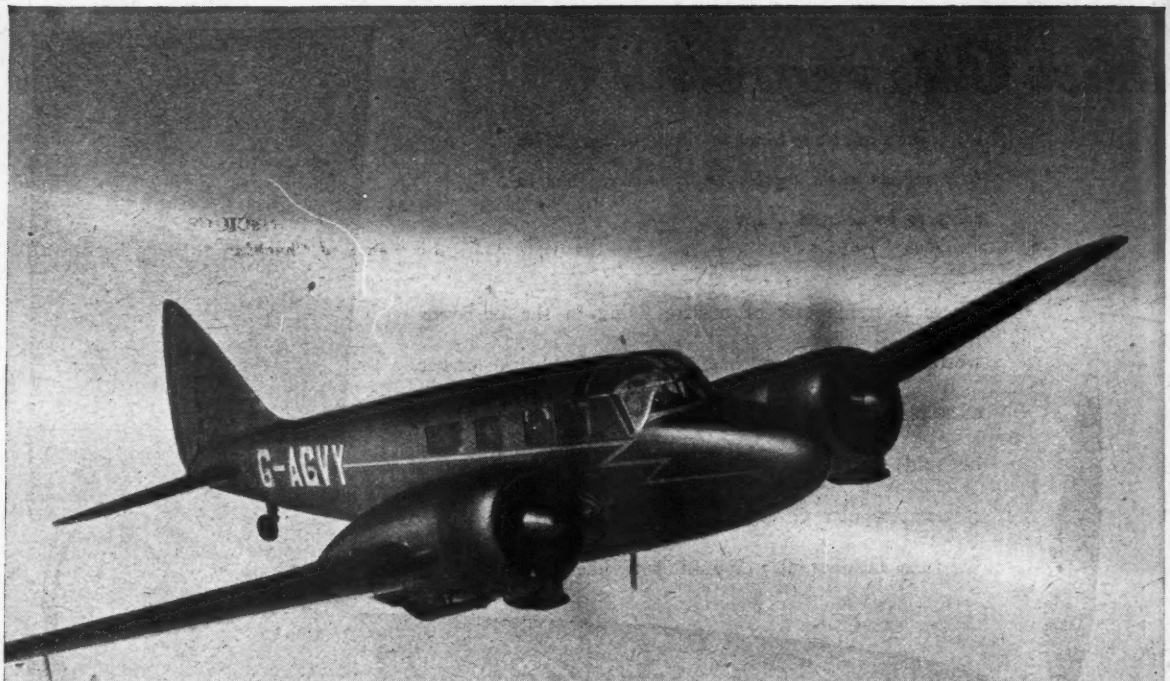

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CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

STOP PRESS

A Jet-propelled Locomotive!

LONDON, March 6 (UP).—The Great Western Railway is studying construction of locomotives based on the jet-propulsion principle, it was disclosed to-day.

PLEASE note the above clipping, from a U.S. daily paper. I can understand a gas-turbine locomotive, but I certainly can't understand a jet-propelled locomotive.

About a year ago one of our officials wanted to know how much horse-power was required to operate a full-sized train by the use of jet propulsion. My calculations, which were very rough, estimated it would require at least 50,000 h.p. for the principal reason that the maximum speed of the train would be only 100 m.p.h. or thereabouts, and there would be a tremendous amount of "slippage" in the jet stream as compared to the surrounding air. Of course, a gas-turbine locomotive with a conventional transmission would take about 5,000 h.p. for the same train. R. T. S.

New York.

CASE AGAINST HEATHROW

Prestwick's Better Weather Record

REGARDING "Kibitzer's" mention (*Flight*, March 14th, 1946) of Heathrow's "man-made haze and fog," I would point out that Prestwick Airport does not suffer from visibility so bad that the airport has to be closed to any appreciable extent (two closed days in the year). The conditions at Prestwick are phenomenally good and possibly are not equalled on the western seaboard of Europe.

I would like to say that I am surprised, to put it mildly, that you persistently ignore the various advantages of Prestwick over Heathrow. HECTOR SOUTTER.

LONG-DISTANCE RECORD

Fuel Consumption of the Wimpey

WITH reference to the two letters by Mr. J. L. Coverdale (*Flight*, February 7th and 28th), I must join with your contributor, Mr. R. G. Lofting (*Flight*, February 28th) in querying the load and range figures tabulated by Mr. Coverdale.

I am not personally acquainted with the cruising figures of the Lancaster I, but I can assure him that he would not manage 24 gall/engine/hour on his hypothetical long-range "Wimpey."

At its operational weight of some 34,000 lb, optimum cruising consumption of the Wellington Ic was 30 gall/engine/hr. At the all-up weight suggested of 39,700 lb, of course, this figure would worsen somewhat.

It would also appear that at this wing loading (47.2 lb/sq ft) and power loading 19.8 lb/h.p., a pretty generous length of runway would be indicated, as the "unsticking" speed would be in the neighbourhood of 105 m.p.h. J. C. ELKINS.

FUEL AND WEIGHT

A Problem in Consumption Rate

I WONDER if any of your readers could answer the following question. The problem concerns two heavy bombers; B-24s of the same mark and both equipped with "Ceco" carburettors. Both aircraft take-off on a range-flying exercise; aircraft "A" weighs 52,000 lb and aircraft "B" weighs 62,000 lb. Both aircraft use the power settings of "auto-lean mixture, 32in m.p., 2,200 r.p.m."

I maintain that if the power settings are not changed both aircraft will consume the same quantity of petrol per hour. Naturally, aircraft "B" will arrive at base later than "A" because of its heavier weight, and, consequently, decreased i.a.s. I, therefore, come to the conclusion that both machines use the same number of gallons per hour, but that aircraft "B" has a lower a.m.p.g. and consumes more petrol.

My late Flight Engineer Leader believes that aircraft "B" must consume more gal/hr—even though both "A" and "B" maintain the same power setting—because it is the heavier of the two.

Both engineers and the Pratt and Whitney engine technical representative agree with me, but he still remains stubborn. Could anyone enlighten me? "MIXTURE."

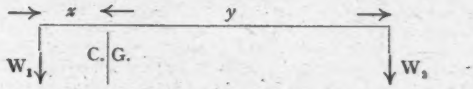
ON BEING C.G. CONSCIOUS

A Simple Means of Checking Load

THE letter in *Flight*, March 7th, by John Howard, under the above heading, suggests to me that there is a very simple and efficient means of preventing overloading or bad loading of any aircraft.

If a pair of weighbridges is arranged so that the main wheels of an aircraft can rest on one bridge, while the tail or front wheel is on the other, then the total weight of aircraft and load will be the sum of the two weighbridge readings. Overloading will be apparent if present.

The proportion between the two readings must be constant for a given aircraft, no matter what the load, if the C.G. is to be maintained in its correct place.



Taking moments about the C.G.

$$W_1.x = W_2.y$$

$$\text{then } \frac{W_1}{W_2} = \frac{y}{x}$$

W_1 = wt. on main wheels. W_2 = wt. on fore or aft wheel.

Now $\frac{y}{x}$ is a constant for any aircraft, since the position of the main and fore or aft wheels and the C.G. are fixed.

It follows that for any given aircraft the wheel loadings should bear a constant proportion whatever the total weight, and this figure could be clearly marked on the aircraft, and would be as important to the machine as is the Plimsoll line to a ship.

By using two weighbridges the cargo could be arranged in the best position and readings would instantly show when the aircraft was safe.

Technical difficulties in laying out weighbridge equipment to suit the varying wheelbase lengths could no doubt be overcome, and the cost of such an installation would be negligible in comparison with additional safety ensured.

W. G. HARROW.

Best Position for the Datum Point

WHILE fully agreeing with Mr. Howard's views as to the necessity for the utmost care in loading transport aircraft (*Flight*, March 7th), I cannot help feeling that these proposed simplifications are likely to make matters even more confusing.

The suggestion to rename the datum "balance point" brings to mind the story of the pilot officer who, when asked to define "the centre of gravity of an aircraft," replied: "It is a point usually indicated by a white cross on the side of the aircraft." The term "balance point" suggests that the aircraft should balance at the indicated spot, and I hate to think of the number of P/Os who would then confuse the centre of gravity with the datum point, possibly with disastrous results if they loaded their aircraft to this point.

While in theory Mr. Howard's suggestion of placing the datum point at approximately the centre of the cargo space may be good, in practice it is often impracticable and in any case it is undesirable. If the correspondent has ever been present at the weighing of an aircraft he will understand the need for having the datum at a point from which a plumb-line can be dropped to the floor without fouling the wing, which it normally would do if the datum were placed at the cargo centre of a low-wing monoplane. It is undesirable to have the datum point at the centre of the cargo hold owing to the introduction of positive and negative moment arms and moments, and I need hardly emphasize what might be the result of a "minus sign" being overlooked.

Undoubtedly the best position for the datum of a transport aircraft is at the front end of the cabin in order that the ground crew can measure the moment arm of any item of cargo directly, regardless of its vertical or lateral position in the cabin. Using this datum will, in most cases, result in all

CORRESPONDENCE

variable items of load (i.e., those for which the weight, arm and moment cannot be read directly from the loading chart, such as fuel and cargo) having positive moment arms, thus eliminating any errors due to the omission of the minus sign.

I agree that it is desirable that a loading diagram be placed in the aircraft and maybe the weight sheet now carried in all civil aircraft could be suitably modified to incorporate this data.

GRAHAME K. GATES.

IN SEARCH OF SAFETY

Parachutes for All Passengers

WITH reference to E. G. Smart's letter on preserving evidence of sea crashes in *Flight*, February 23rd, his idea for certain members of aircrew to be told to bale out when trouble is in the offing is a good one But what of the effect on the minds of potential air passengers? Will they demand similar dinghy-parachute type packs so that passengers and crew can all bale out when and if the moment arrives? If the crew are going to be provided with this gear, the argument may well be put forward that "What is sauce for the goose, etc."

Why not cut down the number of passengers per aircraft, and provide all with dinghy-'chute packs, so that all will have an even chance of survival from a crash? Larger exits, or more, may help in the quicker departure of passengers and crew from the aircraft when the order to bale out is given.

The inference in E. G. Smart's idea is that passengers will still continue to be killed and injured while accident investigation and prevention departments wait for the evidence of aircrew who have baled out from crashing airliners in order to "iron out," one by one, the many, many causes of aircraft accidents. The finding and correcting of one fault which caused a crash will not result in an immediate cessation of air crashes.

However, I do agree with E. G. Smart. His idea certainly does seem to be the one certain way of getting some evidence as to why an aircraft crashed, especially when the crash happens well out to sea where there is little or no chance of recovering the wreckage. There certainly doesn't seem to be any other way of preserving evidence about crashes at sea when total loss of the machine is involved.

Why not fit airliners with flotation bags which automatically fill out when the aircraft touches water? It seems a worthwhile idea even if it means cutting down the number of passengers carried.

Then, let's have the heavy units of the airliner made jettisonable. Such as main landing gear, engines, etc.; flotation will then be made a bit more certain, with the possibly undesirable loss of evidence concerning cause of crash, i.e., engine failure. The argument here will be, "Shall we save the passengers' and crews' lives, or shall we keep down the margin of safety whilst we collect more evidence about why aircraft crash?"—With the idea, of course, that after the sacrifice of a lot more lives we shall eventually evolve the uncrashable aircraft.

With regard to airliners being fitted with means to keep them afloat, the peacetime continuation of air-sea-rescue, which saved so many lives during the war, should be most urgently considered. Flying boats and small, fast ships should be held in readiness to go out to the rescue on receipt of an S O S. Rescue work should not be left to the individual efforts of ships which may happen to be in or near the area where an aircraft has crashed.

More consideration for the passengers' welfare and safety, and a little less attention to more speed, more altitude, bigger aircraft, etc., will bring about that better air transport which most airline operators strive for and somehow never get.

F. C. HUNT.

FOR THE BOOKSHELF

Jane's All the World's Aircraft, 1945/46. *Sampson Low, Marston and Co., Ltd. Three guineas net.*

AERONAUTICAL bibliophiles and students—particularly Americans, we believe—are paying anything up to twenty-five guineas for a 1919 edition of Jane's *All the World's Aircraft*, now the standard work on the later types used in the 1914-18 war. If this is true, its counterpart for the war of 39-45 should prove not only an unrivalled work of reference, but an attractive financial investment. But whatever motive prompts its acquisition, merely to glance through its glossy pages is quite an adventure: they present for analytical study all the great Allied and German aircraft which so bitterly contested air supremacy in the later phases of the war.

The industrious editor, Mr. Leonard Bridgman, judging from the tone of his preface, must have felt like his predecessor, C. G. Grey, when he introduced the 1919 issue by wishing, almost, "for the simple condition of war when there was a fixed regulation for everything" and by sympathizing with the dog whose muzzle is removed after a prolonged Muzzling Order. His trials can only be imagined by anyone with a knowledge of book production and of the shifting channels through which aeronautical information must pass, but the outcome is remarkable for its thoroughness and orderly presentation, despite the necessity for Addenda pages.

It should not be inferred that the work is essentially retrospective in character; the section on gas turbine power plants embodies the most recently promulgated data on British units, while many of the aircraft described are prototypes of designs which will be familiar in the pages of Jane's for years to come.

H. F. K.

"The Gyroscope and its Applications." Edited by Martin Davidson, D.Sc., F.R.A.S. Hutchinson's Scientific and Technical Publications. 21*s.*

IN this excellent book is packed a greater overall fund of data on the gyroscope and gyroscopic devices than can probably be found between any other two covers yet produced. Dr. Davidson suggests in the introduction that the book should be regarded as but a reliable *introduction* and not as an exhaustive treatise. Certainly, however, the content matter is exhaustive in the fields covered, and more than enough data is supplied to satisfy anyone other than the absolute specialist who might require a treatise on a single aspect of application or theory.

G. C. Saul A.I.N.A., F.R.A.S., is responsible for Section II, which covers Marine Applications, and J. A. Wells, A.F.R.Ae.S., and A P. Glenny, B.Sc., have collaborated to produce Section III on Aeronautical Applications.

This book should have a place in every technical library and on the bookshelf of every technician whose field embraces gyroscopics.

"Dictionary of Aeronautical Terms." By Grp. Capt. H. Nelson, C.B.E. Pitman. 10*s* 6*d.*

THIS dictionary fulfils a want that has existed for a long time. The compiler notes in his preface that during his thirty-two years' connection with aviation he has collected explanations of various terms with which he has had to deal, and the dictionary is the result of this pursuit.

Nevertheless, sundry terms which could well have been included are missing; e.g., Impeller, Compressor, Warren-girder and Precession, to mention but four. Further, it is interesting to see that the antonym of "dihedral" angle is given as "cathedral" angle; whereas we have always understood that the normally accepted antonym is "anhedral" angle. Perhaps "cathedral" is derived from the early days when Col. Cody was flying his *Cathedral*, the wings of which had a pronounced spanwise droop when at rest.

"Scientific Instruments." Edited by H. J. Cooper, B.Sc., A.R.C.Sc.I., A.M.I.E.E. Hutchinson's Scientific and Technical Publications. 25*s.*

SPECIALIZATION is inseparable from our highly organized way of life, and a concomitant of specialization is that the worker in one field of endeavour may well be relatively ignorant of how the worker in a different field carries on his work.

As applied to instruments, this can mean that one scientist, although completely at home with his own equipment, may not know the ins and outs of equipment used by his colleagues; there is every reason why he should have a ground knowledge of this sort, however, because the specialized instruments of one field may well be adaptable to other purposes in fields of widely divergent investigation.

This book is an excellent attempt to cover the generalities of instrumentation and is divided into five sections, *viz.*: I, Optical Instruments; II, Measuring Instruments; III, Navigational and Surveying Instruments; IV, Liquid Testing; and V, Miscellaneous.

C. B. B.-W.

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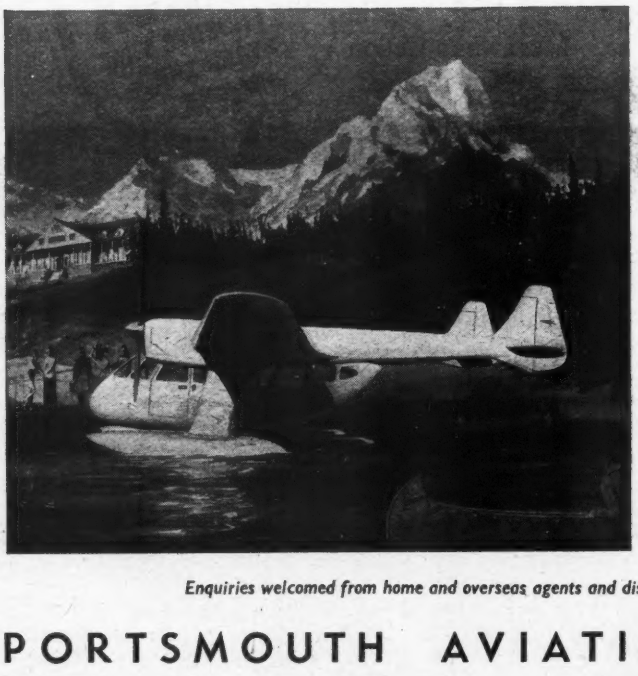

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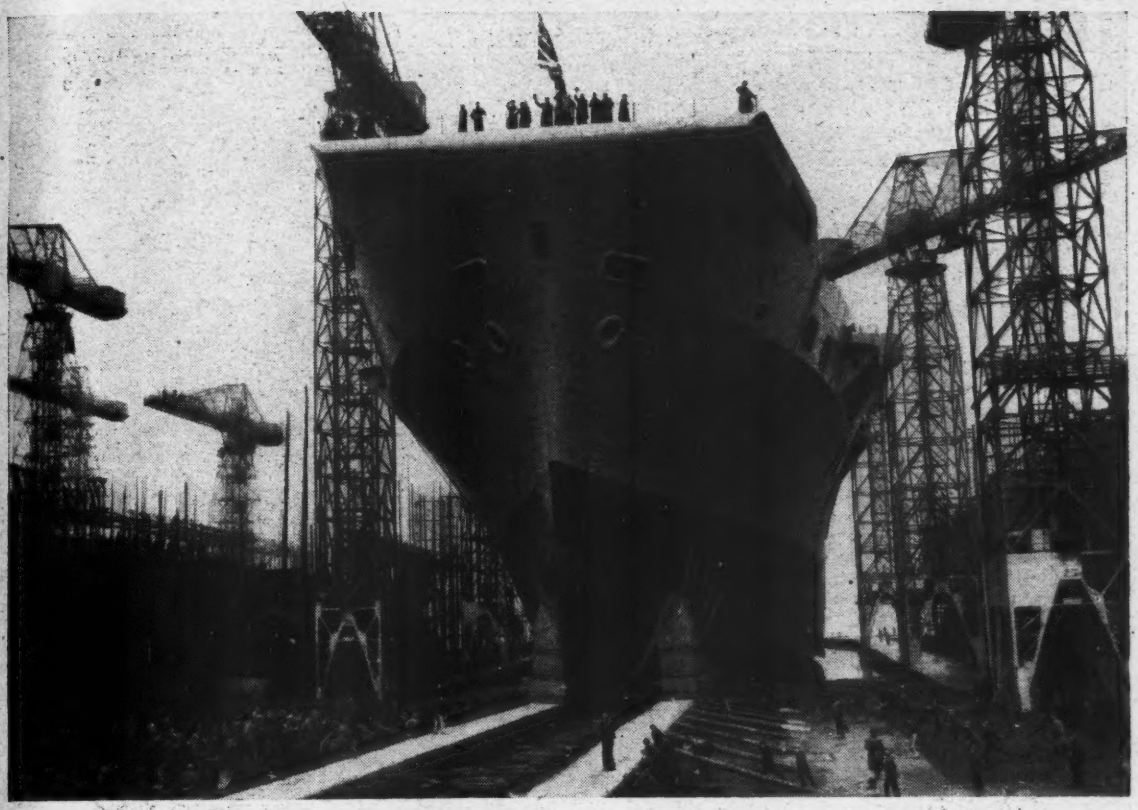

FOR NAVAL AIR-POWER: H.M.S. *Eagle*, Britain's latest aircraft-carrier, believed to have a displacement of over 40,000 tons, making her one of the largest in the world, was launched by Princess Elizabeth on March 19th. The *Eagle*, which is the first of the new Ark Royal class, is here seen sliding down the slipway into the Musgrave Channel, Belfast.

SERVICE AVIATION

Royal Air Force and Naval Air Arm News and Announcements

Demobilisation

Improvement on February Announcement

ADVANCE notification of the release programme of the R.A.F. and W.A.A.F. up to the end of May shows an improvement on the groups expected to be reached when last month's announcement was made for this period. Instead of R.A.F. groups up to 35 being scheduled up to the end of June, as formerly promulgated, officer aircrew up to and including group 36, and airmen aircrew up to and including group 38 will be released by the end of May, but with the exception of meteorological air observers.

The general level of release for airwomen is raised to group 45, and for W.A.A.F. officers to group 44, but it is stated that some unavoidable variations remain in the groups to be released among both R.A.F. and W.A.A.F. officers, in employments in which it has not been possible to make good current shortages by retaining personnel from other branches.

The standard release group of ground airmen is raised to group 35 by the end of May instead of June; in some trades it will be up to and including group 36 by this date. Again there will be exceptions in the case of the accounting trades whose position is under consideration, and in the case of meteorologists.

Awards

Royal Air Force

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

Distinguished Service Order

Flt. Lt. V. PHILLIPS, R.A.F., No. 487 (R.N.Z.A.F.) Sqn.—This officer has taken part in many operational sorties. In May, 1943, he was navigator in the leading aircraft of a force of eleven aircraft detailed for an attack against the Power Station at Amsterdam. When the enemy coast was reached, heavy opposition from anti-aircraft fire and enemy fighters was encountered and one of our aircraft was badly damaged and forced to turn back. Large formations of enemy fighters then attacked and the fighter escort were unable to protect the bombers. During the approach to the target six more of our aircraft were shot down, but the leading pilot pressed on with the remaining three aircraft and without fighter escort. When over the target these three aircraft were shot down, but the leader, assisted by this officer as navigator, located and bombed the target before his aircraft was also shot down in flames. Flt. Lt. Phillips was taken prisoner of war. Throughout this hazardous flight this officer displayed outstanding coolness, courage and devotion to duty, continuing with his duties despite the heavy attacks being made on his aircraft by enemy fighters.

Second Bar to Distinguished Flying Cross

Flt. Lt. M. D. SEALE, D.F.C., R.A.A.F., No. 357 Sqn.—This officer has completed a large number of operational flying hours and has participated in three tours of operational duty. As squadron navigation officer he has worked with great efficiency and enthusiasm. Flt. Lt. Seale has always reached his target, even in the most adverse weather. He completed three long range sorties to Malaya, dropping stores and personnel by parachute, in the Singapore area. Throughout Flt. Lt. Seale has set a magnificent example of determination and devotion to duty.

Bar to Distinguished Flying Cross

Act. Sqn. Ldr. W. McD. SOUTER, D.F.C., R.A.F.V.R., No. 42 Sqn.

Distinguished Flying Cross

Act. Wing Cdr. P. C. JOEL, R.A.F.O., No. 110 Sqn.
Act. Sqn. Ldr. G. T. A. DOUGLAS, R.A.F., No. 34 Sqn.
Act. Sqn. Ldr. R. W. WILLIAMS, R.A.F.V.R., No. 159 Sqn.
Flt. Lt. J. W. S. CLARK, R.A.F.V.R., No. 684 Sqn.
Flt. Lt. T. E. EDWARD, R.A.F.V.R., No. 684 Sqn.
Flt. Lt. A. McK. GALL, R.A.F.V.R., No. 159 Sqn.
Flt. Lt. R. P. S. HARRIDENCE, R.A.F.V.R., No. 47 Sqn.
Flt. Lt. R. L. HUSBAND, R.A.F.V.R., No. 358 Sqn.
Flt. Lt. E. C. HYDE, R.A.F.V.R., No. 500 Sqn.
Flt. Lt. T. J. McCOLL, R.A.F.V.R., No. 240 Sqn.
Flt. Lt. A. A. MORLEY, D.F.M., R.A.F.V.R., No. 357 Sqn.
Flt. Lt. G. A. MYERS, R.A.F.V.R., No. 240 Sqn.

SERVICE AVIATION

Flt. Lt. G. R. OAKLEY, R.A.F.V.R., No. 159 Sqn.
Flt. Lt. P. A. S. PAYNE, R.A.F.V.R., No. 47 Sqn.
Flt. Lt. D. L. WILLIAMSON, R.A.F.V.R., No. 34 Sqn.
Flt. Lt. W. YOUNG, R.A.F.V.R., No. 79 Sqn.
F/O. D. A. JONES, R.A.F.V.R., No. 159 Sqn.
F/O J. E. SHARWOOD-SMITH, R.A.F.V.R., No. 47 Sqn.
P/O. F. SMITH, R.A.F.V.R., No. 159 Sqn.
W/O. (now P/O.) F. W. BRIDGER, R.A.F.V.R., No. 93 Sqn.
W/O. R. MEREDITH, R.A.F.V.R., No. 47 Sqn.
W/O. F. W. POREE, R.A.F.V.R., No. 47 Sqn.
W/O. G. W. POWELL, R.A.F.V.R., No. 47 Sqn.
W/O. W. C. H. OUTHWAITE, R.A.F.V.R., No. 47 Sqn.
W/O. C. G. TAYLOR, R.A.F.V.R., No 684 Sqn.
Flt. Lt. L. E. GIESELMAN, R.C.A.F., No. 47 Sqn.
Flt. Lt. S. KINNEAR, R.C.A.F., No. 159 Sqn.
Act. Sqn. Ldr. R. E. STOUT, R.N.Z.A.F., No. 70 Sqn.
F/O. J. E. HAYCOCK, R.N.Z.A.F., No. 159 Sqn.

Distinguished Flying Medal

Flt. Sgt. R. CASTLEDINE, R.A.F.V.R., No. 357 Sqn.
Flt. Sgt. (now P/O.) S. DELOW, R.A.F.V.R., No. 55 Sqn.
Flt. Sgt J. A. MORRIS, R.A.F.V.R., No. 250 Sqn.
Sgt. J. DAWSON, R.A.F.V.R., No. 601 Sqn.

THE KING has been graciously pleased to approve the following awards:—

Military Cross

Act. Sqn. Ldr. G. WHITEHEAD, R.A.F.V.R.
W/O. S. K. GORDON-POWELL, R.A.F.V.R., No. 35 Sqn.

Distinguished Conduct Medal

Sgt. J. R. SMITH, M.M., R.A.F.V.R.

Foreign Decorations

THE KING has granted unrestricted permission for the wearing of the undermentioned decorations conferred upon the personnel indicated in recognition of valuable services rendered in connection with the war:—

Conferred by the President of the United States of America

Distinguished Service Medal

Marshal of the Royal Air Force The Viscount PORTAL OF HUNGERFORD, G.C.B., O.M., D.S.O., M.C.

Legion of Merit

Degree of Commander

Air Chief Marshal Sir DOUGLAS C. S. EVILL, G.B.E., K.C.B., D.S.C., A.F.C., R.A.F.
Air Chief Marshal Sir RICHARD E. C. PEIRSE, K.C.B., D.S.O., A.F.C., R.A.F. (Ret.).

Roll of Honour

Casualty Communiqué No. 568.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list, 245 are second entries giving later information of casualties published in earlier lists

Royal Air Force

KILLED IN ACTION.—Wing Cdr. R. C. Crawford, D.F.C.; Flt. Lt. F. M. Forrester.

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. R. C. Bebe; Flt. Sgt. G. F. Craven; F/O. B. D. Culbert; Sgt. A. Y. Davies; Flt. Sgt. S. Duckles; Flt. Sgt. R. J. Dunn; F/O. R. T. W. Holt; Flt. Sgt. A. McIntosh; Sgt. J. Steele; Flt. Sgt. J. Steele; Flt. Sgt. W. G. Stevens.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. Allan; Flt. Lt. O. B. Andrews; Sgt. R. W. Bennett; Sgt. A. W. T. Boulton; Sgt. D. T. Muir; Act. Flt. Lt. H. M. Proctor, D.F.C.; Sgt. F. T. H. Rookwood.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. D. Aird; F/O. L. S. Ajrekar; Flt. Sgt. J. S. Archibald; W/O. E. L. Armitage; Sgt. C. Ashley; Act. F/O. J. P. Austin; Flt. Sgt. R. R. Baines; Flt. Sgt. F. J. Barrett; Flt. Sgt. G. A. Crow; Flt. Sgt. F. W. A. Bickmore; F/O. W. T. Bolt; P/O. E. G. Boucher; Sgt. G. E. Brook; W/O. N. Brook; Sgt. H. Brown; F/O. E. N. Calvert; F/O. G. R. Chaffe; Sgt. A. J. Cherry; Act. Sqn. Ldr. R. C. Chopping, D.F.C.; P/O. L. W. Coghlan; P/O. R. J. Cooke; Sgt. E. J. Cottridge; F/O. C. W. Crabtree; Flt. Lt. A. M. Crow, D.F.M.; Act. Wing Cdr. P. B. N. Davis, D.S.O.; P/O. L. B. Dawson; Flt. Sgt. J. A. G. Dixon; Flt. Lt. L. S. Dobson; Flt. Sgt. F. C. A. Dow; Flt. Sgt. R. Dowson; P/O. N. W. Easby; Sgt. J. S. Eastham; Flt. Sgt. S. Elliott, A.F.M.; Sgt. K. Farnden; F/O. R. W. J. Fennell; Flt. Sgt. C. Fletcher; F/O. N. T. Foster; Sgt. F. G. M. Fox; Act. Flt. Lt. K. W. L. Fuller, D.F.C.; Sgt. K. Gaythorpe; F/O. K. Gibbs, D.F.C.; F/O. W. T. Gilmore; Sgt. E. B. Grasso; Flt Sgt. P. C. Green; Flt. Lt. The Hon. B. D. Grimston, D.F.C.; Sqn. Ldr. H. C. Haley; L.A/C. A. Halstead; Sgt. C. A. Harris; W/O. J. C. H. Harrison; Sgt. E. J. Hartmann; F/O. D. F. Haste; Sgt. D. Hetherington; W/O. R. L. Hinchliffe; Sgt. C. Hore; Sgt. W. Huddart; Sgt. D. W. Hughes; Wing Cdr. J. H. Humphris; Sgt. E. W. Hunter; Sqn. Ldr. R. H. James; Sgt. J. T. Kermack; P/O. W. M. Knowles; Flt. Sgt. W. E. Leake; Flt. Sgt. J. V. Lee; W/O. A. T. Lyon; Sgt. J. A. Macklin; Flt. Sgt. H. V. McLanachan; Flt. Lt. F. Mason; Flt. Sgt. W. J. Massey; Sgt. A. D. Mellish; Sgt. L. H. Mercer; Sgt. M. Mills; Sgt. K. W. Molyneux; F/O. R. J. Moore; F/O. R. B. Moore; Sgt. J. H. Morrison; Sgt. J. H. Moule; Flt. Sgt. J. Myles; Sgt. J. Newlands; F/O. R. W. Orbell; Sgt. L. O'Toole; Flt. Sgt. R. C. Owen; W/O. E. H. J. Page; Sgt. R. C. Pain; Act. Flt. Lt. R. S. Palandri; Sgt. T. V. Parsons; F/O. W. Pedlow; W/O. F. F. Pitt; Sgt. M. S. Popple; Sgt. J. E. Porter; Sgt. J. R. Pryor; Flt. Sgt. A. Reid; Flt. Sgt. J. M. Reid; P/O. B. A. Reynolds; Sgt. B. Richardson; Sgt. M. J. Robertson; Flt. Sgt. R. W. Robinson; Flt. Sgt. J. H. C. Ross; Flt. Sgt. W. Ross; Sgt. N. Rowe; Sgt. L. Rudd; Sgt. A. Sandilands; Sgt. R. H. C. Scott; Sgt. B. Sellers; Sgt. A. Sharpe; F/O. C. C. Smith; Wing Cdr. N. J. Starr, D.F.C.; L.A/C. J. A. W. Statham; Sgt. R. V. Stonier; Sgt. J. L. Swanson; P/O. I. R. Thomas; Sgt. J. Thorley; P/O. J. N. Thorne; Sgt. T. W. H. Tomlinson; Flt. Lt. J. S. Towsey; Flt. Sgt. W. J. Treadwell; Flt. Sgt. M. J. Wallen; F/O. W. Warhurst; F/O. J. H. L. Watkins; Sgt. K. G. Webb; P/O. E. R. White; Sgt. J. C. Whyte.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. D. J. Allaway. F/O. J. E. Brown; W/O. K. E. Button; Sgt. L. M. Gill; Sgt. R. T. Hill; F/O. H. Johnson; Sgt. T. E. Jones; Sgt. J. S. Kinsey; Sgt. W. G. Nisbett; Flt. Sgt. R. G. Phillips; F/O. D. S. Thomas; F/O. P. W. Tooley; Sgt. R. Whittington.

MISSING.—F/O. J. R. Andrew, D.F.M.; W/O. K. Illingworth; Sgt. A. W. Robertson; Flt. Sgt. K. J. Stor ar; Flt. Sgt. G. E. Tuck; Flt. Lt. L. Unsworth.

KILLED ON ACTIVE SERVICE.—Sgt. A. M. Adams; F/O. W. J. Boots; Sgt. A. H. H. Clarke; W/O. L. F. A. Closs; Sgt V. J. Cooper; P/O. G. Douglas; L.A/C. J. C. Fairlie; Flt. Sgt. W. A. Fowler; F/O. R. A. J. Graham; F/O. N. F. Hewitt; Flt. Sgt. K. G. Mayne; P/O. L. S. Morley; P/O. A. J. F. Parish; Sgt. R. E. G. Seymour; Sgt. F. S. Smith; Sgt. B. J. Sudlow; F/O. K. E. Sutton-Brown; Flt. Sgt. P. Taylor; Sgt. D. B. Tuck; Sgt. W. Way; P/O. G. Whelan; P/O. H. C. Willis; Sgt. J. Winstanley.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Act. F/O. G. H. Cowan; Flt. Sgt. D. P. Currie; Sgt. L. W. Jenkins; P/O. J. A. MacLeod; Flt. Sgt. J. Porter; Flt Sgt. F. Reynolds; Flt. Sgt. J. Rhodes; Flt. Sgt. W. E. Smith.

MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. C. A. J. Wilton; P/O. J. C. E. Bayston; Sgt. D. V. Sorfleet.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. T. H. Osborne.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. W. H. Chowns; Flt. Lt. A. E. Lee.

DIED ON ACTIVE SERVICE.—Sgt. J. L. Barrett; Sgt. J. Bennett; L.A/C. T. A. Blackhurst; L.A/C. N. J. Chope; Cpl. S. T. Cook; L.A/C. H. Crawford; Flt. Sgt. T. G. Dunbar; L.A/C. E. C. Farrow; L.A/C. S. Fenton; L.A/C. R. French; A/C.2 A. Hancock; A/C.2 N. R. W. Hill; W/O. H. P. Lowman; Cpl. A. G. May; A/C.2 H. N. Mousoos; L.A/C. S. W. Mousley; L.A/C. L. O. Mutton; F/O. M. J. O'Toole; W/O. R. E. Preston; W/O. A. G. C. Read; P/O. R. D. B. Stephenson; Sqn. Ldr. R. F. E. Wickham; Flt. Sgt. J. H. Wood; L.A/C. G. W. Yarnall.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. D. F. Belk.

Royal Australian Air Force

KILLED IN ACTION.—F/O. N. W. Neelands. Flt. Sgt. A. O. Walkington.

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Badge of No. 512 Squadron, Royal Air Force—"Pegasus militans" (Fighting Pegasus).

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. G. S. C. Bell; P/O. J. M. Carter; F/O. L. A. Kempson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. H. B. Armstrong; Flt. Sgt. B. R. Barber; F/O. R. H. Buchan-Hepburn; F/O. N. E. Butler; Flt. Sgt. M. E. Dickenson; P/O. A. J. Duncan; Flt. Sgt. H. J. Earl; Flt. Sgt. J. J. Fallon; P/O. S. H. Fitzhenry; F/O. K. W. Gale, D.F.C.; F/O. M. C. Gray; Flt. Sgt. B. A. Hands; P/O. P. W. Hogan; P/O. W. Hough; Flt. Sgt. L. G. L. Hunter; P/O. S. R. James; W/O. B. E. Kelly; Flt. Sgt. A. A. Kennedy; Act. F/O. J. F. Kreiter; W/O. R. W. Lett; Flt. Lt. J. P. Liversidge; W/O. G. R. C. Lowe; W/O. A. W. Lyon; Flt. Sgt. W. R. McAuliffe; Flt. Sgt. D. McAully; W/O. J. A. McDonald; Flt. Sgt. L. G. McKenzie; Flt. Sgt. R. L. Malor; F/O. A. S. Miller; Flt. Sgt. E. A. Parry; W/O. A. W. Pryor; Flt. Sgt. K. P. Samson; Flt. Lt. R. H. Small; Flt. Sgt. J. N. Tresidder; P/O. G. M. Walker; W/O. W. J. L. Whale; Flt. Sgt. J. D. Whitby.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. C. Clement; F/O. J. A. D. McGill; F/O. F. C. Sanders; Flt. Sgt. W. J. Seale; W/O. W. B. Webb.

KILLED ON ACTIVE SERVICE.—W/O. I. W. Dent; F/O. R. S. Horwood.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—F/O. J. D. C. Bell.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Flt. Sgt. R. H. Pye; Flt. Sgt. M. J. Turner.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. J. W. Barber; P/O. D. F. J. Baxter; Flt. Lt. R. R. Boulter; F/O. H. Braathen; F/O. J. H. Bringloe; W/O. W. E. Brown; P/O. C. J. Campbell; P/O. J. W. Carter; P/O. M. K. Christie; F/O. W. G. Crawford; F/O. W. D. M. Devine; F/O. C. B. Dockrey; F/O. B. F. Edwards; F/O. R. N. Elwin; P/O. J. Faragher; Flt. Sgt. S. R. Frith; P/O. G. E. Germiquet; F/O. A. E. E. Gourdeau; Flt. Lt. J. R. Hanson, D.F.C.; P/O. F. C. Harman; F/O. E. O. Heyworth; W/O. O. A. Keddy; P/O. W. A. Langrill; P/O. J. P. O. V. Levesque; P/O. H. D. Lewis; Flt. Sgt. J. M. Lonie; Flt. Sgt. J. M. McLeod; F/O. O. H. Mennie; F/O. D. Moriarty; P/O. F. E. Morton; P/O. V. P. Obright; F/O. H. McC. Patterson; P/O. P. Poulos; W/O. O. J. L. Pratlett; F/O. H. Sager; P/O. R. H. Sparling; F/O. J. R. Steepe; Flt. Sgt. C. B. Wylie.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Flt. Lt. K. F. Sage.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—F/O. J. E. Clements; F/O. D. R. Jones; Flt. Lt. R. J. Land; Flt. Lt. J. E. Porter; P/O. C. O. Powell.

MISSING.—Flt. Lt. A. E. F. Anderson; Sgt. W. G. Bond; F/O. E. F. Elford; Sgt. A. Maxwell; F/O. A. McA. Silverthorn; Sgt. W. A. Vaudner.

KILLED ON ACTIVE SERVICE.—Flt. Lt. T. L. Lewis; F/O. P. J. Lim; Flt. Lt. J. H. Skelly.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Cpl. H. W. Boyd; Sgt. F. D. Bristow; Sgt. M. G. Casey; Sgt. D. McLean; Sgt. H. P. Veregin; Sgt. J. F. Yacko.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. W. Holowaty.

DIED ON ACTIVE SERVICE.—Cpl. L. J. Kight; L.A/C. A. W. Lefevre; F/O. G. W. Parliament.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. G. I. Hodgson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Flt. Lt. J. D. Lunn.

KILLED ON ACTIVE SERVICE.—W/O. G. G. Kendall.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Lt. W. E. Jay.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Cpl. P. M. R. Hodoul; Lt. H. Thistleton.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Lt. J. B. Miller.

KILLED ON ACTIVE SERVICE.—Capt. D. C. Greef; Lt. J. B. Lockwood; Lt. E. C. Martin; Lt. O. C. Meiklejohn; Air Mech. M. Morice; Air Mech. M. M. Pretorius; Lt. J. Sutherland; Lt. E. H. Wells.

Official Corrections

Casualty Communiqué No. 573.

R.A.F.—Under KILLED IN ACTION, for Flt. Sgt. G. T. Watkins read W/O. G. T. Watkins.

Under PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION, add the following: F/O. J. A. Law, D.F.C., Flt. Sgt. D. E. Olden, Sgt. P. West.

Under PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION, to the name Act. Flt. Lt. R. Brook add D.F.C.

Delete MISSING, BELIEVED KILLED IN ACTION and the names beneath.

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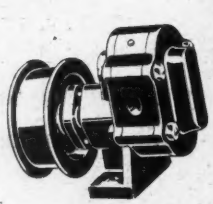

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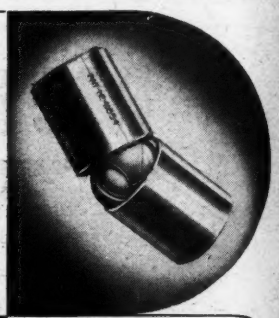

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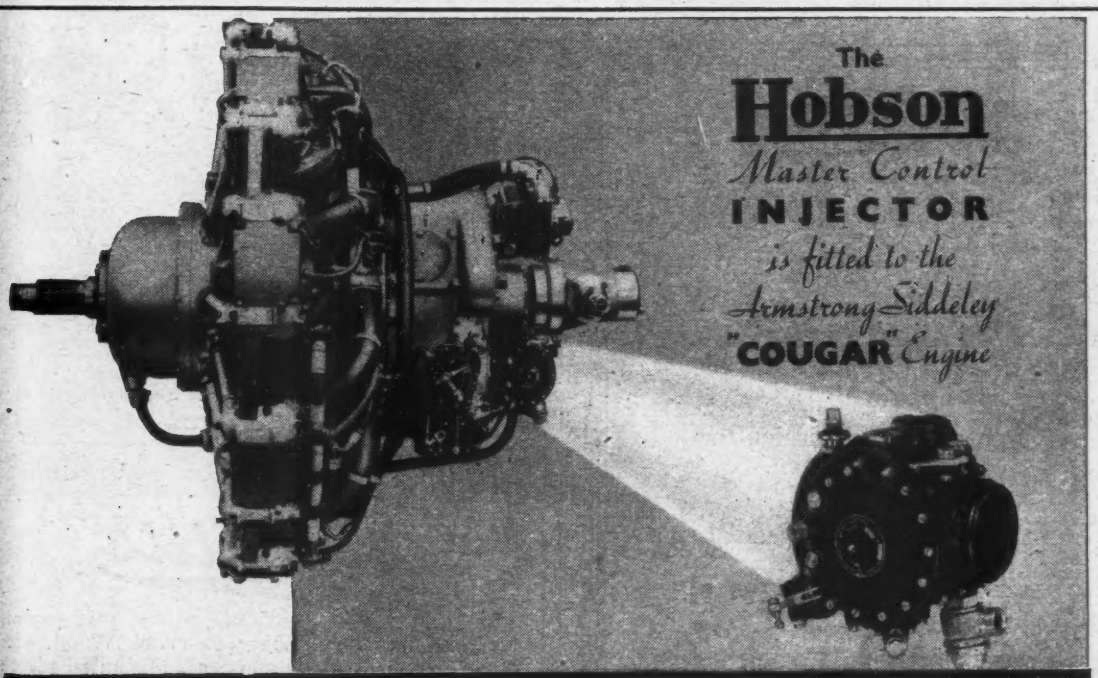

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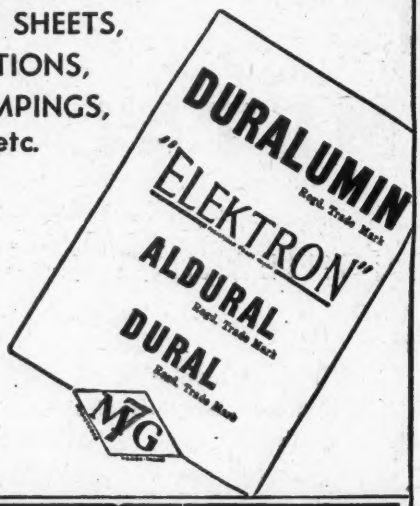

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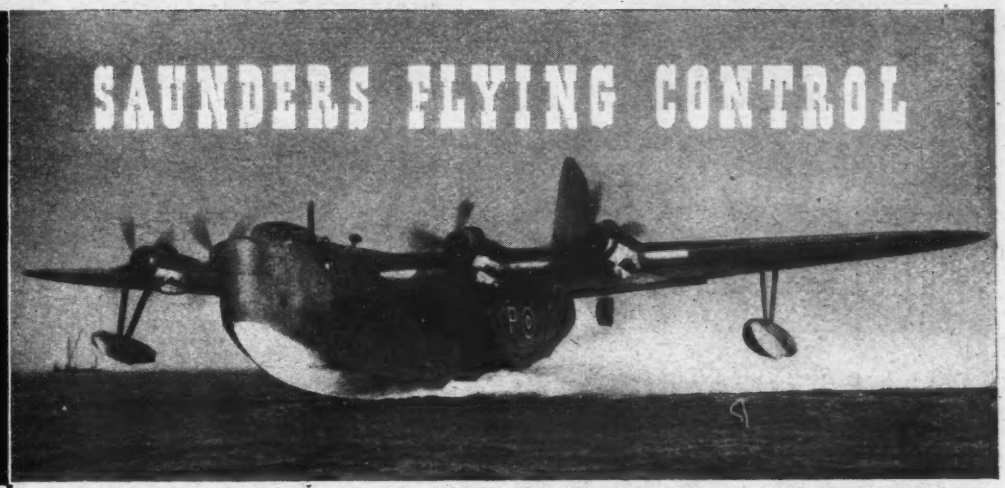

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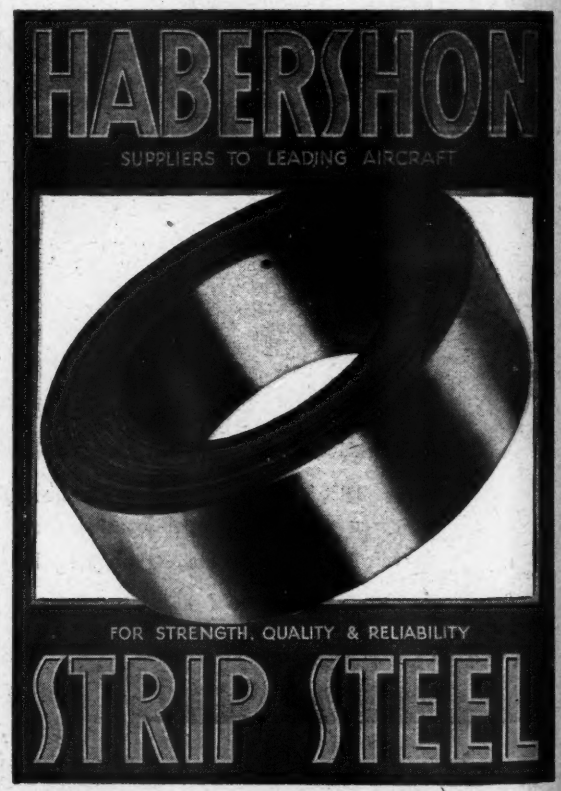

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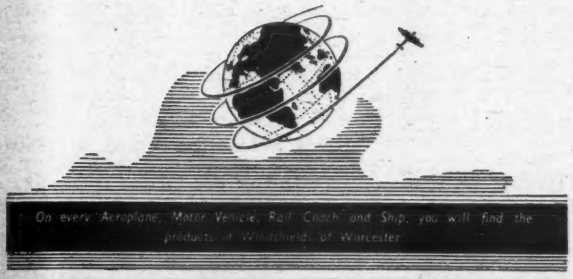

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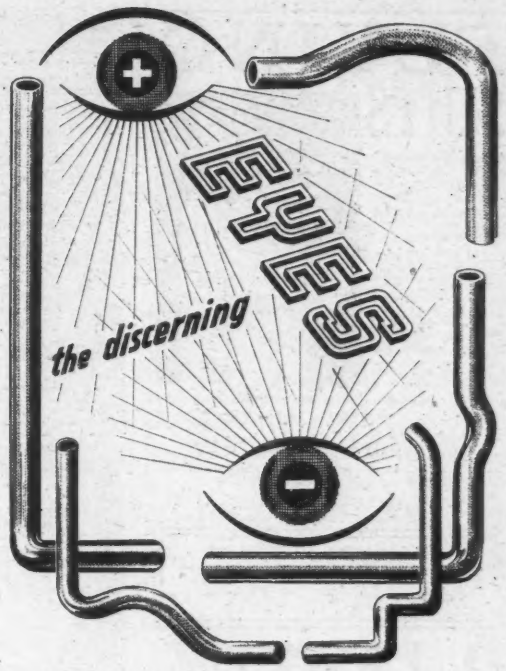

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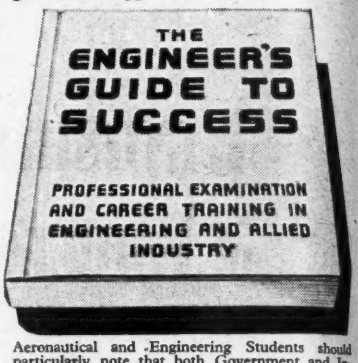

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OILSKINS free of coupons.—Surplus from public utility company, and reconditioned as new; suit consists of heavy black oilskin ¾ length coat, shoulders interlined, button to neck, with storm collar, also heavy black oilskin trousers, guaranteed absolutely waterproof; price 35/- per suit, postage 1/- extra; sou'-wester to match, 3/- extra; all sizes orderable; state chest and waist measurement when ordering; limited supplies; cash back if dissatisfied; also A.R.P. yellow oilskin coats, full length, 15/6.—Willson Brothers (Dept 14), Epsom, Surrey. [0234

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FOR sale, Rolls-Bentley 1936 sports saloon, special body, fitted suitcases and many extra features, recently overhauled by makers, condition as new, taxed for year; £2,200.—Southern Aircraft (Gatwick), Ltd., Gatwick Airport, Surrey. Tel. No.: Crawley 811. [6717

CAR HIRE SERVICE

FORCES personnel on leave from abroad requiring cars should apply to Wilson's (Brixton), Ltd., Trinity Gardens, London, S.W.9. Brixton 4011. [0228

PATENTS

THE Patentees of British Patent No. 541,606 for "Improvements in Parachutes and Parachute Packs" wish to make arrangements to grant licences under this Patent.—Address enquiries to F. J. Cleveland & Co., Chartered Patent Agents, 29, Southampton Buildings, London, W.C.2. [6760

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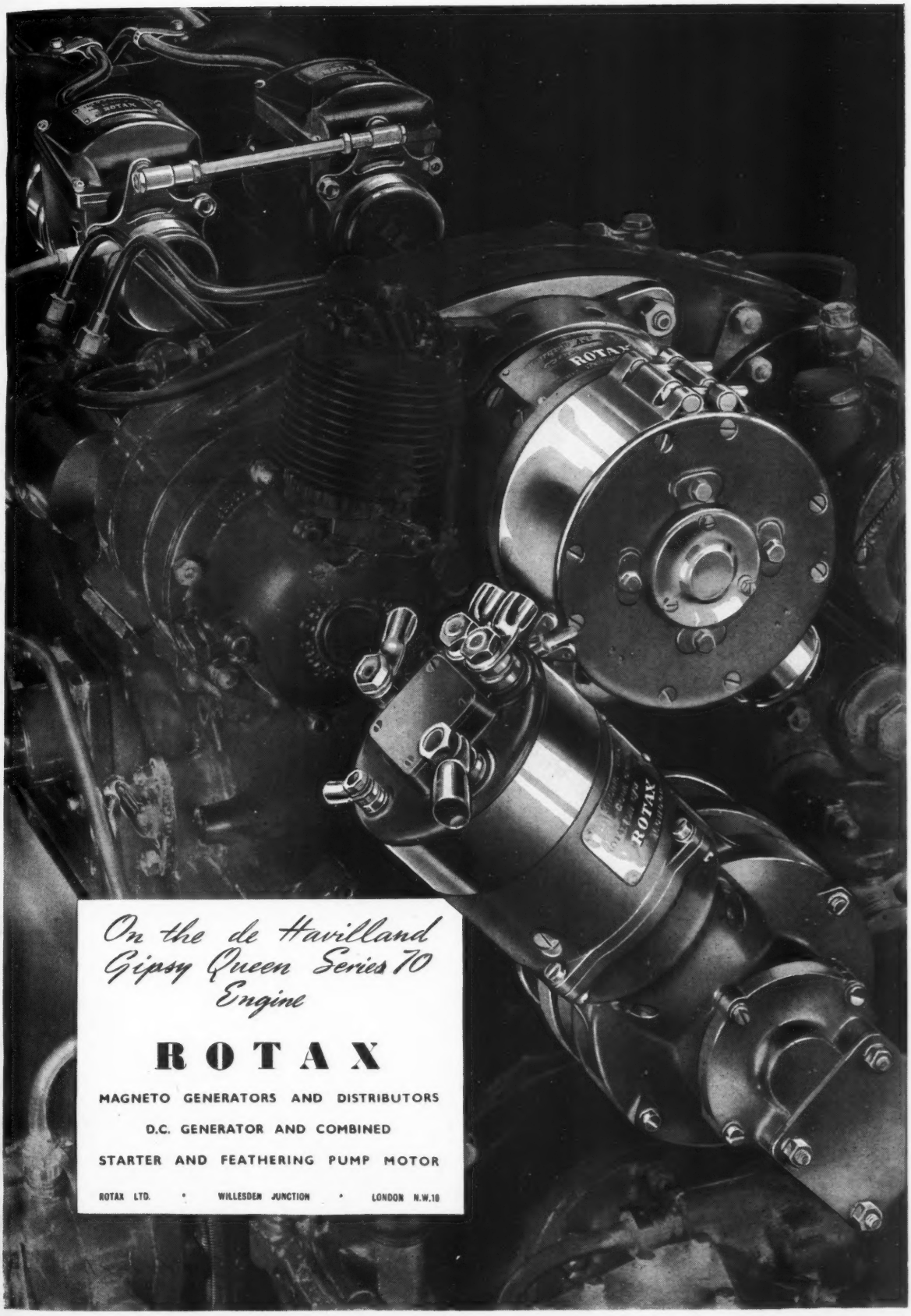
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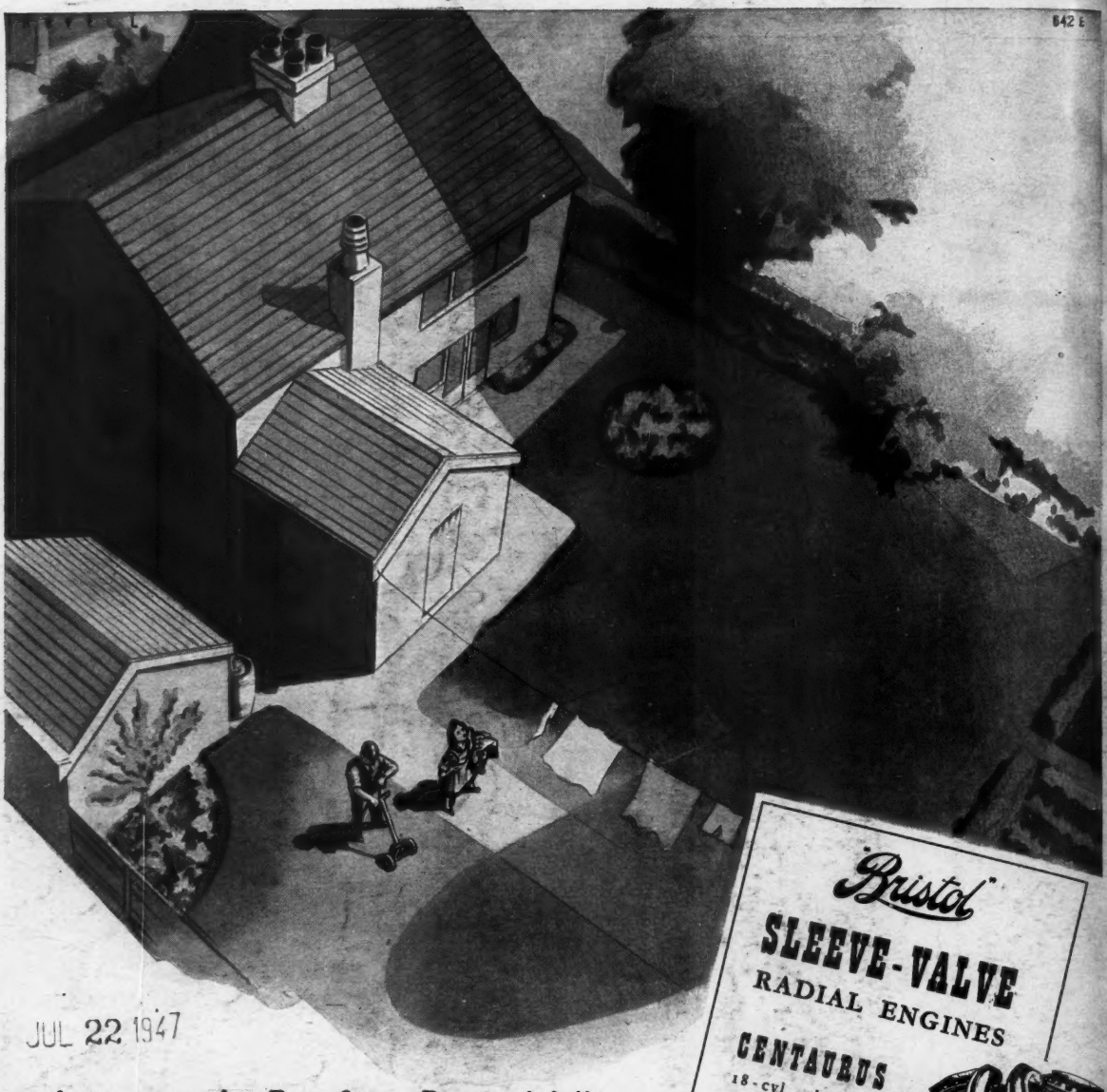

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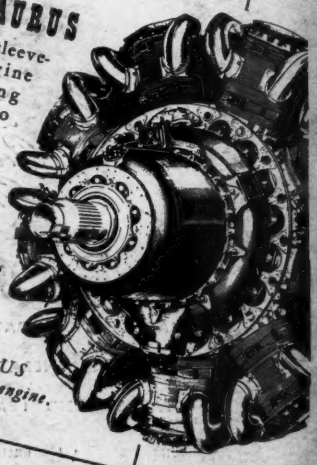

Illustration shows: the CENTAURUS *18-cyl. sleeve-valve engine.*

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